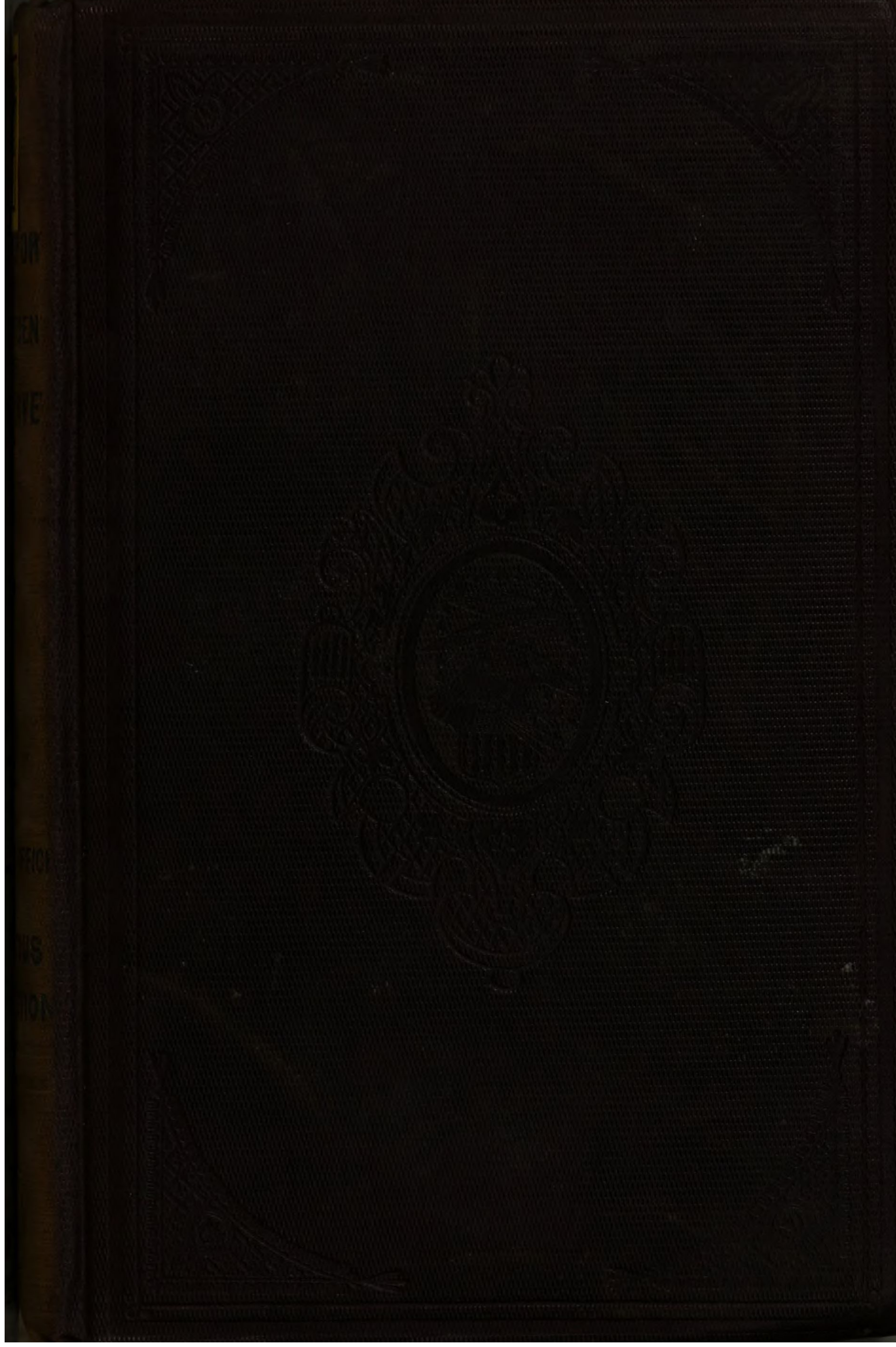




1874/1875

With the compliments of

A. D. BACHE

33d Congress,
1st Session.

[REDACTED]

Vol. 1
No. 1

ANNUAL REPORT

OF THE

SUPERINTENDENT OF THE COAST SURVEY,

SHOWING

THE PROGRESS OF THAT WORK

DURING

THE YEAR ENDING NOVEMBER, 1851.

WASHINGTON:
ROBERT ARMSTRONG, PRINTER.
1852.

32d CONGRESS,
1st Session.

[SENATE.]

Ex. Doc.
No. 3.

ANNUAL REPORT

OF THE

SUPERINTENDENT OF THE COAST SURVEY,

SHOWING

THE PROGRESS OF THAT WORK

DURING

THE YEAR ENDING NOVEMBER, 1851.

WASHINGTON:
ROBERT ARMSTRONG, PRINTER.
1852.

Bayerische
Staatsbibliothek
München

LETTER

FROM

THE SECRETARY OF THE TREASURY,

COMMUNICATING

The report of the Superintendent of the Coast Survey, showing the progress of that work during the year ending November, 1851.

TREASURY DEPARTMENT,

December 5, 1851.

SIR: I have the honor to submit, for the information of the Senate, the accompanying report, made to the department by Professor A. D. Bache, Superintendent of the Coast Survey, showing the progress of said work during the year ending November, 1851. All of which is respectfully submitted.

THO. CORWIN,

Secretary of the Treasury.

Hon. W. R. KING,

President of the Senate.

REPORT OF THE SUPERINTENDENT OF THE COAST SURVEY.

COAST SURVEY STATION,

Cape Small Point, Maine, November 5, 1851.

SIR: I have the honor to submit the annual report, required by the regulations, of the progress of the survey of the coast of the United States, for the information of the department and of the President and Congress.

The appropriation asked for the last fiscal year provided for work on portions of the whole extended coast of the Atlantic, Gulf of Mexico, and Pacific, in the proportions deemed necessary for the wants of commerce and navigation, or desirable from the different stages of progress at the several points, or economical in reference to the distribution of the parties according to the best working seasons.

The plan which has for some years been pursued, with the approval of the executive and legislative authorities, has been steadily adhered to. The coast of the Atlantic and Gulf of Mexico, extending over

nearly nineteen and a half degrees of latitude and thirty and a half of longitude, is divided into nine sections of nearly equal extent of shore line, following the minute indentations of the coast; and the survey is begun in each, and advanced each year, as far as the means appropriated permit. A base line measured in each section, and observations made for latitude and azimuth at appropriate points, furnish data for the preliminary maps and charts of the sections, without waiting for the completion of the whole work; while the system provides for the joining of the parts and the verifications, which are necessary in all extended surveys, and without which the accuracy desirable and attainable would by no means be reached. To derive matured fruit from such a plan, it must be steadily prosecuted to its completion. It is most advantageous for reasons which I have, in former reports, dwelt upon in detail. It avoids exclusive attention to one part of the coast and neglect of the rest, permitting a ready adaptation to general or local wants. It accommodates itself to the facilities or difficulties presented by the different natural features of the coast, by which the rate of progress of the whole work in different places, or of different operations in the same region, varies. It facilitates the division of labor, which is an important element of progress and of economy; and permits the execution of each operation at the best season or period, which is equally important. It is not less flexible in lending itself to the scientific, than the practical and economical requirements of different cases.

What it is capable of doing when steadily followed out, is illustrated by sections three and four, in which, while the necessary data for maps, charts, and sketches have been furnished from year to year, the triangulations have been advancing—one from Kent Island base, southward, in Maryland and Virginia; the other from the Bodie's Island base, North Carolina—until they are now within less than fifty miles of each other. Two seasons will enable us to join them, and then the results will verify each other.

Similar plans are in progress for each of the sections, requiring only careful adjustment to the features of the coast to insure, finally, all the perfection of a geodetic survey. The continuance of the fostering care of the Executive and Congress in the uninterrupted execution of these plans, will bring them certainly to maturity. The time of completion will depend upon the means which a judicious economy may consider available to this portion of the public service. Every increase of the appropriation, up to the point when the work would become unwieldy, and unity of design and execution would be sacrificed to rapidity, is attended with not only a corresponding decrease in time, but with more than a proportionate decrease. I have considered it a duty, while adhering generally to the limits which Congress has determined at a particular time to appropriate, to represent to the Treasury Department the cases in which an increase is demanded for the successful progress of different parts of the survey.

The plan for prosecuting the survey of the western coast, so as to meet the wants of a commerce increasing with a rapidity which has no precedent, and the peculiar condition of the country in other respects, was presented in my last report, and is briefly repeated in this. It will require, for a few years, the application of larger means than will after-

wards be needed. Until we can place that coast at least on a footing in respect to surveys with that which resulted from efforts in colonial times, in respect to the Atlantic coast, I am convinced that duty requires me to urge the supply of more than ordinary means to meet an extraordinary case. On what coast before has commerce been developed, from the outset, by the aid of steam?—altering all the usual relations of time, draught, and course, and I may add, of value from a single loss. When has it before occurred that a locality, marked on charts four years since as a mere trading establishment for skins, should have grown into a city, the fourth—in such a country as the United States—in the amount of revenue collected for the general treasury? We have assuredly not yet come up to the requirements of such a commerce.

I have before remarked that the plan of the survey furnished data for immediate use. In fact, between one-fourth and one-third of the annual appropriation is devoted to what is classed as office work, consisting in computation, reduction, drawing, engraving, electrotyping, printing, and publishing. Usually, the publication of the results of a work is estimated for separately; but here it goes to swell the total amount. It is advantageous not to separate the two sets of estimates, as it permits the adaptation of the field and water work and of the publication to each other in due relation, notwithstanding the varying circumstances which cannot be anticipated, and which are sometimes beyond control, in changing the amount of one or the other. When a work, from its magnitude, necessarily occupies a number of years, to postpone the publication of its results until its completion is to deprive the public of all advantage from it until the highest is attainable. We have proceeded upon the opposite plan—that of endeavoring to give results as fast as they can be obtained. Not to give those as final which are really only approximate, but stating the degree of approximation; to give them in such a shape as will make them immediately useful, increasing the refinements in the form in which they are presented as the increased accuracy of the determinations permits. The sketches intended to give information to nautical men and others, which accompanied my report in 1849, were fifteen in number, while in the present report they are thirty-three; and eight notices to mariners, some of them very extended, have been published in the course of the year. This not only diffuses the information derived from the survey while it is fresh, but it reacts powerfully on the work itself, giving a strong but healthful stimulus to those who are engaged in it by enabling them at once to realize a portion of the credit of their labors. It improves the details, too, by presenting them in such a shape that their merits or defects can be fairly weighed. It fixes responsibility, and gives immediate credit for well-executed work. I would even go further than this, by publishing the data derived from observation, and, when they admit of it, the observations themselves. I am satisfied that the additional expenditure which would thus be required would repay itself many times in the efficiency of the work, the security from loss, the diffusion of information as to methods and results of observation, and in the great facility for such publication while the persons by whom the observations are made are still actually occupied in the same work, and all the minute particulars are fresh in their minds. This plan is much to

be preferred to that of deferring the publication until the close of the survey.

With the present report will be presented a list of geographical positions, 3,240 in number, derived from the preliminary calculations of the work. The degree of accuracy which has been reached in the different sections will be explained when considering the details. It will be found that improved methods of determining the latitudes by observation have been employed; that the various methods which astronomy and geodesy furnish for determining longitudes have been applied; and that, in addition to the usual ones, we have introduced for the first time, as part of a geodetic work, the determination of difference of longitude by the telegraph. This list will receive revision from time to time; but its publication now will afford very useful data to geographers, surveyors, and even to astronomers. It will be followed by others relating to magnetism and the tides. This is a new feature in the annual report, and, with the extension of the number of sketches, will add materially to the interest which it would have as a report of progress.

For the development of the plans of office work as facilities have been afforded by the additional appropriations, the urging to completion this list of geographical positions, and the increased rapidity of publication, the coast survey is indebted mainly to the zeal and industry, guided by knowledge and intelligence, of Brevet Major I. I. Stevens, of the corps of engineers, in acknowledging which, in connexion with the remarks on the speedy publication of the results of the survey, I feel that I am doing simply an act of justice.

The organization under which the survey is conducted has been so repeatedly explained and approved, that it needs merely a passing notice. In 1843, a board was convened, under authority and by direction of Congress, embodying in its constitution all the experience which could be furnished by the history of the survey, by consisting of civilians and officers of the navy who had served in it, and officers of the army who had served in it, or were professionally conversant with its details. This board provided for the continuation of the organization which both reasoning and experience found to be the most effective, combining the scientific and practical acquirements of civilians, officers of the army, and officers of the navy, in the work. The survey was recognised as primarily for the benefit of commerce, but having important connexions with defence;—providing for a permanent nucleus of civilians, and for the detail of officers of the army and navy, necessarily varying from time to time in numbers and persons as the exigencies of the military or naval service prevailed over the wants of the survey;—recognising on the one hand that this branch of applied science was a profession requiring long and careful study, and on the other that the practical skill of the naval officer, or the West Point education of the army officer, might most usefully contribute to the progress of the survey;—not excluding the man of science from one of the highest works of applied science which his country has engaged in, nor the army or navy officer from an appropriate sphere of usefulness;—not exposing the work to the contingencies of being arrested by even an alarm of war, nor of excluding the officer of the army or navy from a position in it while his services could be spared from other duty;—not organ-

izing a permanent corps to execute a temporary work, nor yet making the survey a mere school by which all its operations would bear upon them the stamp of the beginner;—combining, as is appropriate to our institutions and our time, the knowledge and experience, wherever to be found, necessary to render its execution creditable to the character of the country. Such an organization could not exist under either the Navy or War Department, and, as most appropriate to a work of commerce, was placed under the direction of the Treasury Department.

Circumstances have forced the closest scrutiny of the organization, progress, results, economy—in short, of every particular relating to the coast survey; and it must be gratifying to the Executive and legislature, who have done so much for its advancement, to find the uniform approval from the highest authorities, both scientific and practical, at home and abroad, which this scrutiny has developed. In this result is to be found the best guaranty, that, if this fostering care is continued, the survey of the coast will be properly completed in a reasonable time, and with a reasonable outlay of means. Within the year, the Geographical Societies of London, Paris, and Berlin, have given the most unequivocal evidence of their interest in, and approval of, the character of the coast survey.

In former reports I have compared the results of the survey on different scales of appropriation with each other. At first, on presenting the plan for its enlargement, it was difficult to convince those upon whom the increase depended that economy would be produced. Each step rendered this less difficult by furnishing positive data in figures. The present scale presents for the Atlantic coast a result of three and a half to one, with an expenditure of less than two to one. (See report of 1850.) So, also, it turns out that the operations which conduce to the essential scientific accuracy of the work are not those which tell most in the sum total of the expenditures; and that while, without those, the character of the work on land would be unworthy of the country, and the hydrography mere reconnaissance, they do not double the cost of the land parties. I have gone into these computations in the report of 1848, and have shown that the cost of measurement of base lines, the astronomical work, and the triangulation, was less than the cost of the topography which was essential to the delineation of the coast; while, in reference to the accuracy of the work, their importance cannot be over-estimated. An examination of the geodetic method, as compared with the mode in use in the Land Office of the United States, showed an aggregate cost per lineal mile for all operations, without the cost of drawing, less than the maximum allowed for the land surveys; and with the finished drawings, a cost but little exceeding it—(\$11 25 per lineal mile. See report of 1848.) As compared with the cost of foreign surveys, the Secretary of the Treasury has shown (see report, Senate Doc., Ex. No. 26, 1849) that this work has largely the advantage in point of economy—an advantage which I apprehend would have been lost to it, if, as in some of the organizations abroad, a permanent corps, deriving its emolument from other service, and only incidentally employed in this, had been organized to execute it; or if intrusted to a body composed entirely of changing elements, not devoted professionally to scientific pursuits.

The lowest estimate which I can make of the progress of the work on the coast of the Atlantic and Gulf of Mexico, is, that at the commencement of this fiscal year more than three-eighths had been completed. This estimate is made from a careful examination of the progress in the different sections. The shore-line to be surveyed has been estimated from the best data which could be obtained; and it is easy in every section, except those where the work has been introduced very recently, to estimate with considerable accuracy its rate of advance. A general reconnaissance has been begun which will much facilitate this calculation, and enable us to introduce the elements of facility or difficulty of survey into the estimates for the time of completion of the different sections. The greater expenditure necessary for the maintenance of each party in the southern sections must enter also into such an estimate, if the total amount to be expended is considered as final. In some portions of the operations, as for example the topography, the smaller number of details necessary in the southern sections diminishes the time required for the survey of a given extent of shore-line, or a given area; but the expenditure in the whole is considerably greater than in the others. The present rate of annual progress is certainly between four and six per cent. of the remaining shore-line.

The time when the work is to be completed, I am aware, is of less consequence than the manner in which it is done. If executed by any but the best methods, it will undoubtedly be done over at some future day. We have not yet found a portion of the coast to which the geodetic method is inapplicable. There may be such, and then we shall not be without resource, but at present we are not compelled at any point to abandon the most exact methods. The mountains of Maine, New Hampshire, and Massachusetts, and the hills from Maine to Maryland, afford every facility for triangulation; the wide expanse of Chesapeake bay in Maryland and Virginia, and of Albemarle and Pamlico sounds in North Carolina; the sea-islands and passages of South Carolina and Georgia; the keys and main of Florida, Mobile bay, and the islands off the coast of Alabama, Mississippi and Louisiana; the bays and prairies of Texas; the bare hills of California; the hills and sounds of Oregon,—are all characteristic features of the several parts of the coast, requiring only to be recalled to the mind to indicate the easy application of the geodetic method to a survey of the coast. The points being well determined and marked on the land, and the shore-line traced, the hydrography is readily executed with the requisite nicety.

Every part of these operations must go on according to a system, or the result fails in completeness, or in economy. This is secured by a general plan of operations, the details of which are submitted by the Superintendent to the Treasury Department, annually; and which, when approved, are executed according to instructions given as to the scientific details by the Superintendent. The modes employed are thus as uniform as can be obtained from the operations of different individuals. The plan of distribution given in Appendix No. 1, is in execution of the "Directions" thus approved by the Secretary of the Treasury in March, 1850, and 1851. At the close of each season,

the assistants report the results of their work, which are embodied in the notices of the several operations in the annual report of the Superintendent.

The resolution of Congress, under which the plan of organization of 1842 was drawn up, required that as many officers of the army and navy as practicable should be employed: the army officers on the land part, and the navy officers on the water part, of the work. The number of army officers was gradually increased from 1844 to 1848, when it had reached fourteen, namely, five staff and nine line officers. These were necessarily removed, with but few exceptions, on the breaking out of the Mexican war; and but for the connexion of civilians with the survey, trained to its operations, the land work would have ceased. Informal notice was given at one time that there might be a necessity for withdrawing also the officers of the navy; but, as the war was not a maritime one, we did not suffer that loss. Soon after the war closed, application was made for the detail, again, of officers of the army, which was met by a request that formal action might be postponed until the regiments were at the posts assigned them. This was in 1848. In 1849 the application was again made and declined, and in 1850 was renewed; and from time to time officers have been detailed until the number now attached to the survey is eleven—namely, four from the engineers and topographical engineers, and seven from the line; and two applications remain not finally disposed of. The names and rank of these officers, and dates of their detail, are given in the Appendix No. 2. Their services have already told in the execution of the operations of the past season, and will be of still further value in those of the next, as they all obtain the necessary experience in the practical operations of the survey now possessed by some.

The number of hydrographic parties has been increased under the injunction of the law, as their services could be rendered available. It now consists of ten parties, of which four are occupied in sections where the seven months which include the summer are most profitable for work afloat; one where the work is done in the autumn and spring; four where the seven months including the winter constitute the best working season; and one is employed during the greater part of the year. This past summer, two of the parties have been transferred from southern sections, at the termination of their working season, to do duty for a time in a more northern one. The average number of officers in each party during the season, afloat, is five. On closing their work afloat, three of each party are allowed by the Navy Department to repair to the office for reducing their hydrography; which, from its nature, cannot be so well done in any other way as under the immediate inspection of those who have executed it. During a brief period in the spring or summer, and during the autumn, the seasons of active employment overlap; but the interval is not considerable between the closing of operations in one set of sections and the beginning of those in the others. The whole number of navy officers on coast survey duty was *fifty-two* on the 1st of March, 1851; and on the 1st of September, 1851, was *sixty-six*. There are on duty afloat, now, when the parties are full, fifty-five officers, and on office duty eleven. The names of the officers detailed are given in Appendix No. 3 and No. 3

bis. The Coast Survey provides the vessels for these parties, keeps them in repair, fits them out, and provides for current surveying expenses from the appropriation. When steam is used, the coal, wood, oil, &c., are provided by the coast survey. The engineers attached to the steamers are from the navy, and the names of those now on service in the Coast Survey are given in Appendix No. 4 and No. 4 *bis.* The transportation of officers is paid by the survey, and during the past year has fallen heavily upon it: officers being directed to report by letter, and not, as heretofore, in person, to the Secretary of the Treasury, so that their transportation in joining has been paid from the appropriation for the survey, and not from the naval appropriation. Draughtsmen are provided, while the parties are in the office, from the coast survey appropriation, being allowed as clerks to the chiefs of parties only when afloat. I have found it necessary to include additional items for these expenses in the estimates for next year. Nearly half the officers of each party being detached from the survey as the parties take up their office work, that afloat is always resumed with the disadvantage of inexperience; which makes the work less valuable and more costly, and sometimes prevents the execution, by the chiefs of parties, of as much as they would desire to accomplish.

While the obligations of the survey to the officers of the army and navy serving on it are freely and fully acknowledged, it should not be forgotten that, on the other hand, the work serves as a school of practice for them, and thus gives while it receives.

The statistics from the records of the Coast Survey office, furnished in the table Appendix No. 5, show the large amount of work done, and of results collected, up to the beginning of 1851. The number of original topographical maps is 301, consisting of 483 sheets; of hydrographical maps 735; and of reduced maps and charts 220. The extent of shore line already surveyed is 11,873 miles.

A list of the discoveries and developments made on different parts of the coast is also printed in the Appendix, (No. 6.) As a summary of these was given in my report of last year, I do not propose at this time to repeat it, but merely to call attention to the new results obtained this year, viz: those upon the Nantucket shoals, as shown in the sketch accompanying this report; the minute survey of the rocks in Hellgate and in Buttermilk channel, to mark the changes effected by blasting; the thorough examination of the Chincoteague shoals, near the entrance to the Chesapeake; the examination of the Frying Pan shoals near Cape Fear, and of Cape Fear entrance; the survey of the harbor of refuge of North Edisto, South Carolina; of Tybee bar and Savannah harbor; of Key West; of the mouths of the Mississippi; and of Humboldt and Trinidad bays, in California.

The importance of circulating the sketch of Nantucket shoals among our navigators is very great; as, notwithstanding that frequent publications have been made in regard to them, vessels still incautiously approach too near them. Within the past summer one of our national vessels touched upon Davis's New South shoal, the position of which was published in 1846. The extent of the Chincoteague shoals and of the Frying Pan shoal appear to have been very erroneously laid down hitherto, and are now given, as well as the depth of water upon them,

in sketches C No. 3, and D No. 8, appended to this report. The harbor of North Edisto, to the south of Charleston, and that of Bull's bay, to the north, furnish safe refuges to vessels finding themselves to leeward of Charleston entrance in bad weather. On this account I have republished, with the present report, the sketch of Bull's bay (E No. 6,) to accompany that of North Edisto, (E No. 7.) The comparison of the present shore line and channel of the entrances to the Mississippi through the Northeast Pass, and the Pass à l'Outre, with the survey made in 1839, is highly instructive, and will be noticed more in detail in the hydrography of Section VIII. The small number of harbors on the western coast, between San Francisco and Columbia river entrance, renders the contribution of the surveys of Trinity bay and Humboldt harbor of the greater relative importance. The charts of the western coast reconnaissance, in three sheets, were engraved, printed and published in twenty working days from the time the drawing was received at the office of the Coast Survey.

As the hydrography advances, tidal stations at important points are occupied, and continuous observations made. Self-registering tide gauges are constructing at the office, which will much facilitate the making of these observations. The results obtained in the Gulf of Mexico from the discussion of the tidal observations are of great interest, leading to the establishment of the laws by which the phenomena are regulated, and bringing within the reach of computation phenomena which were supposed by navigators to be due to the effect of the prevailing winds. Provision has been made for extending these observations during the coming season. I have placed in the Appendix to this report (Nos. 7 and 8) a paper read by me before the American Association for the Advancement of Science, on the tides at Cat island, in the Gulf of Mexico, and on a mode of representing the results of observations of tidal currents; (Sketches H, Nos. 2 to 6, inclusive.)

The observations for longitude, by astronomical observations, by the transportation of chronometers, and by telegraph, have been continued at various points; and notices will be found of them, in connexion with the several sections of the coast to which they belong. The discrepancy, which I have stated in previous reports, between the results of longitude by moon culminations and occultations, has been greatly reduced by the researches of Myers F. Longstreth, of Philadelphia; and the re-computation of our results, with his coefficients of the lunar theory, will be in the highest degree important. We expect, in this matter, to receive important aid from the Nautical Almanac office, under the direction of Lieutenant Charles H. Davis, United States navy.

An account of a second chronometer expedition between Liverpool and Cambridge is given in Section I. At Cambridge, the transits are generally reduced by what has been called by Professor Airy the "American method," as having originated and been brought to its present advanced state in this country; Mr. Bond using an electrical clock and "spring governor," of his invention, for marking the time at Harvard observatory. It is gratifying to national feeling to be able to state that the clock and governor made for the Coast Survey, by Professor Bond and his sons, has received one of the five honorary medals awarded by the commissioners of the late Industrial exhibition.

Charleston and Savannah, (see Section V,) Cambridge and Bangor, (see Section I,) have been connected for difference of longitude by telegraph, and our work has been joined in the same way with that of the British government in Nova Scotia.

Observations for declination of stars, giving irregular results for latitude, were made by Professor Mitchell, of Cincinnati, with the new declination apparatus of his invention, in 1849; and it is very desirable that they should be continued, with the apparatus as improved. This method has undergone the close scrutiny, and has received the approval, of the American Association for the Advancement of Science. A description by Professor Mitchell is given in the Appendix, No. 9.

The work of two more seasons will nearly, or quite, complete the determinations necessary for the appropriate length of the arc of the meridian passing down the Chesapeake, over the space where the measurement of Mason and Dixon was supposed by some to have indicated irregularities in the figure of the earth—while by others the measurement itself was rejected.

The telegraphic connexion between New Orleans and Washington for longitude will, it is expected, be completed next year, which will give the measurement of a portion of a parallel on the Gulf of Mexico, hereafter to be materially extended by the ordinary operations of the survey.

The examination of the Florida reef, made at my request, last winter, by Professor Agassiz, has developed, as was anticipated, the subject of its origin, growth, present character, and probable future progress, and in the most masterly manner. As it is desirable to give the results entire, in full detail, with drawings, and in an appropriate form, I have suggested that it be made a separate communication by the Treasury Department to Congress. In the mean time, I present from it a description of the topography of the keys and reef, which forms one of the chapters, with extracts from other portions of the report, in the Appendix, No. 10. The scientific details are so admirably interwoven with the body of the practical conclusions, that it has been found impossible to present portions of the report without injury to the whole.

One hundred and fifty-eight maps, charts, and preliminary sketches, are now in the hands of the draughtsmen and engravers, or have been published; a list of which is placed in Appendix No. 11, showing the number published, engraved, and in progress. Of these, the following have been engraved during the year to accompany this report, besides nineteen sketches of progress.

I.—*General hydrographic sketches, &c.*

1. Nantucket shoals.
2. Current chart of Boston harbor.
3. Progress of Sandy Hook.
4. Middle Ground, entrance to Chesapeake.
5. Hatteras shoals.
6. Hatteras inlet.
7. Beaufort harbor.
8. Frying-pan shoals.

9. Savannah city.
10. Savannah entrance.
11. Bull's bay.
12. North Edisto.
13. Florida peninsula.
14. Cedar keys.
15. Preliminary chart of Key West.
16. Horn Island pass.
17. Delta of Mississippi.
18. Pass Christian.
19. Mobile bay.
20. Five diagrams of tides at Cat island.
21. Mare Island straits.
22. Trinidad bay.
23. Humboldt bay.
- 24 to 26. McArthur's reconnaissance chart, 3 sheets.
27. Mouth of the Columbia.

II.—*Sketches for location of light-houses, &c.*

1. Holmes's Hole.
2. Beacon ranges, New York.
3. Fishing battery, Chesapeake.
4. Mosquito inlet.
5. Rebecca shoal.
6. Aransas pass.
7. Galveston bay.
8. San Diego.
9. Point Conception.
10. Point Pinos.
11. San Francisco entrance.
12. Humboldt bay.
13. Cape Hancock.

Hydrographic notices have been published by authority of the Treasury Department, and distributed within the past year, in relation to the following localities and subjects, important to the navigating interests of the country:

1. On the draught of vessels which can enter the south channel of the Columbia river, Oregon.
2. Sailing directions for entering the Columbia river as far as the harbor of Astoria.
3. Description of the islands and rivers between the harbor of Monterey and mouth of Columbia river.
4. Correction in the position of the Farallones and Point Lobos, entrance to San Francisco bay.
5. Information in relation to North Edisto harbor of refuge, South Carolina.
6. Information in relation to San Diego, Humboldt, and Trinidad harbors, western coast.
7. Extract from Lieutenant Commanding Alden's letter, in relation to Humboldt harbor and Trinidad bay.

8. Report of the latitude and longitude of Point Conception.

The list of geographical positions appended to this report (Appendix No. 12) contains the trigonometrical points of the coast survey determined up to July, 1850; and also the positions of a number of permanent objects determined by means of the plane table. The list is accompanied by sketches showing the positions of the points referred to. A preface explains generally the divisions of the coast which are referred to; and, in a popular way, the mode of determining the distances, latitudes, longitudes, and azimuths, which the table contains, their connexion through the figure of the earth, and their variation due to irregularities of figure and density. The degree of approximation which may be expected from the results of the computation, according to the stage of progress towards the final conclusions, is pointed out. The arrangement of the different parts of the table is also fully explained. Great care will be required in the revision of the printing of this useful list; and even with it, errors must be expected, which, however, a subsequent impression will in a considerable degree correct.

The act of 3d of March, 1851, required an important class of duties of the Superintendent of the Coast Survey, namely: to provide for the examination of the sites of light-houses, beacons, buoys, &c., for which appropriations were made, and which, in the opinion of the Fifth Auditor, required examination.

“SEC. 2. *And be it further enacted*, That if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house, or light-boat, beacon or buoy, or to ascertain more fully what the public exigency demands, the Secretary of the Treasury shall thereupon direct the Superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes.

“SEC. 3. *And be it further enacted*, That the officer so directed shall forthwith enter upon the discharge of the duty; and, after fully ascertaining the facts, shall report: First, whether the proposed facility to navigation is the most suitable for the exigency which exists; and, second, where it should be placed if the interests of commerce demand it; third, if the thing proposed be not the most suitable, whether it is expedient to make any other kind of improvement; fourth, whether the proposed light has any connexion with other lights, and, if so, whether it cannot be so located as to subserve both the general and the local wants of trade and navigation; and, fifth, whether there be any, and if any, what other facts of importance touching the subject.

“SEC. 4. *And be it further enacted*, That all such reports shall, as speedily as may be, be laid before the Secretary of the Treasury; and if such as to authorize the work, without further legislation, he shall forthwith proceed with it, otherwise such reports shall be laid before Congress at the next ensuing session; but, in all cases when the person designated by the Secretary of the Treasury, under the second section of this act, does not report such preliminary examination as expedient, the provisions of this act shall, without delay, be carried into execution.”

The Secretary of the Treasury, in conformity with the first clause of the second section of the act quoted above, called upon the Fifth Auditor to report the cases in which preliminary surveys were necessary to determine the sites of the objects provided for and enumerated in the act. He reported that, with three exceptions, he had "no knowledge of the reasons on which the several appropriations were made," and that "the necessity for the examination was apparent from the many lights on the coast and lakes, and the fact that on some parts of the coast the lights are now so numerous that it is impossible to distinguish one from another, and they are hence becoming a nuisance." (See Appendix No. 14, *bis*.)

In pursuance of the report of the Fifth Auditor, the Treasury Department gave me instructions on the 29th of March last, (see Appendix No. 13,) to proceed with the examination on the Atlantic coast, the Gulf of Mexico, and Pacific, including thirty-six localities from Maine to Texas, and on the western coast from Humboldt harbor, California, to the mouth of the Columbia river, Oregon.

Instructions, more or less detailed, were issued by me, as early as practicable, to the assistants of the coast survey operating in or near these localities, directing surveys, reconnaissances, or examinations, as the cases required. Upon these reports the decision required by the law was made, and all the facts of the case communicated for the information of the department. These valuable reports of the assistants, usually accompanied by maps or sketches, or referring to the published maps of the coast survey, are embodied in the Appendix to the present report, under the heads of the different sections of the coast. The results are also briefly stated in the same connexion in the body of the report.

A detailed list of the subjects of my reports, in tabular form, is presented in the Appendix, (No. 15,) including the section of the survey in which the work was done; the name of the State, the special locality, the name of the object appropriated for, the officer by whom the examination was made, the date and nature of my reports. The table also contains the results of examination for sites of light-houses, &c., required under the act of Congress of the previous year, viz: those at Fort Point in the bay of San Francisco, at Point Conception, Point Pinos, near Monterey, Point Loma, near San Diego, California, and Cape Hancock or Disappointment, mouth of Columbia river.

The only objects remaining not reported upon are a light-house and fog-signal at Umqua, in Oregon, and two on the coast of North Carolina, the sites for which are under examination, and upon which reports may soon be expected.

The examinations were made in eleven States, viz: Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, North Carolina, Florida, Texas, California, and in Oregon Territory. And the objects reported upon are as follows: light-houses, eighteen; harbor or "bug" lights, three; beacons, six; light-boats, three; buoys, thirty-three; spindles, two; fog-bell, one; fog-whistles, four; floating bell-beacon, one. The special localities of these objects are given at length in the table, (Appendix No. 15,) and the details of the examinations are treated of under the heads of the different sections of the

coast, and in the reports of the hydrographic assistants of the coast survey, which are given in the Appendix. The information embodied in these reports has been obtained through the facilities furnished by the distribution of the parties of the coast survey in all the sections of the coast, at a merely nominal expense—less indeed than one thousand dollars—while the information obtained of a reliable sort from the assistants of the work, will effect a saving of many thousands. The zealous and efficient assistant in charge of the office of the Coast Survey has caused the drawings required to illustrate the reports to be promptly made and forwarded to the department. Nor have the steps taken to procure the reports interfered in any case, that I am aware of, seriously, with the duties of the Superintendent and assistants, being rather incidental than foreign to the other duties in which they are engaged.

In July last a letter was addressed to me by the secretary of the Light-house Board, created by act of Congress of March last, requesting inquiries of the chiefs of hydrographic parties of the coast survey in regard to light-houses and accessories on the coast. I addressed a circular to the officers thus referred to, and have transmitted their replies to the board. Several of their replies contain recommendations of new light-houses, beacons, buoys, &c., which are referred to in their annual reports. I have embodied them with other recommendations of assistants in the survey, and have given extracts relating to them from the reports. (Appendix, No. 16.) They embrace objects in the States of Maine, Massachusetts, New York, North Carolina, South Carolina, Florida, Texas, and California. (For a tabular list of these objects see Appendix, No. 17.)

The object of my annual report is twofold—one, to give an account of the progress of the survey; and the other, to furnish information which has been derived from it, and which may be of interest to commerce and navigation. The preliminary statements are intended, very briefly and in a general way, to call attention to the most prominent points relating to either of these objects; to give a condensed statement of the progress of each part of the work, an outline of the progress which may be expected during the ensuing *fiscal* year, and the estimate of its cost. Following the divisions of the coast into sections which has been adopted in the work, I next give a more detailed account of the several operations, stating by whom they have been executed, and their results, derived from the annual reports of the assistants and others employed, and prefacing these details by a notice of portions of the work in each section. In this part of the report I have felt at liberty to incorporate such statistics as are useful in the course of the survey in the office or field. Justice to the arduous labors of those who engage in the difficult operations of the work requires that they should receive a full acknowledgment of the service rendered. The progress of the out-door work is brought up to the first of October in all cases, and, when it is practicable, to the first of November; that of the office work to November.

The division of the coast into sections is as follows:

I. Passamaquoddy bay to Point Judith, including the coast of the States of Maine, New Hampshire, Massachusetts, and Rhode Island.

II. From Point Judith to Cape Henlopen, including the coast of Connecticut, New York, Pennsylvania, and part of Delaware.

III. From Cape Henlopen to Cape Henry, including the coast of Delaware, Maryland, and part of Virginia.

IV. From Cape Henry to Cape Fear, including the coast of the State of North Carolina.

V. From Cape Fear to the St. Mary's river, including the coast of the States of South Carolina and Georgia.

VI. From the St. Mary's river to St. Joseph's bay, coast of Florida, and including the Florida Reef and Keys.

VII. From St. Joseph's bay to Mobile bay.

VIII. From Mobile bay to Vermillion bay, including the coast of Alabama, Mississippi, and part of Louisiana.

IX. From Vermillion bay to the boundary, including the coast of part of Louisiana and of Texas.

X and XI. The coast of California and Oregon.

The triangulation is continuous, with one single interval of about fifty miles, which less than two seasons more will close, from the mouth of the Kennebec, in Maine, to Ocracoke inlet, in North Carolina, and is well advanced in South Carolina, Georgia, Florida, Louisiana, and Texas, and nearly completed in Alabama and Mississippi; and the other parts of the work are based upon this and keep pace with it. The survey of the western coast is making vigorous progress, striking first at the determinations most important to navigation. That the survey is not advanced more equally in the different sections, will be understood from the dates at which the appropriation has permitted the introduction of the operations on their full scale in them.

The work was in progress in all its main branches first in the different sections as follows: In No. I, in 1844; in No. III, in 1844; in No. IV, in 1847; in No. V, in 1849; in No. VI, in 1850; in No. VIII, in 1847; in No. IX, in 1850. No. II was nearly completed in 1844. In No. VI there is merely a reconnaissance, the appropriation not allowing the commencement of the other operations there. The operations on the western coast are necessarily, for the present, of a kind appropriate to the peculiar circumstances of the country.

The loss of the steamer Jefferson on the coast of Patagonia, on her voyage to the western coast, has seriously impeded the work which was laid out for the season in sections X and XI. The light-house surveys ordered by Congress on the western coast may be postponed for a brief time in consequence of this loss; but the arrangements made by the Treasury Department, to equip the steamer Corwin and to send her to that coast, will soon place the hydrography there on the footing designed for it. It will be recollected that the Corwin was constructed for the western coast; but that in order to save the working season of this, the Jefferson, considered in every respect suitable for the purpose, (see Appendix, No. 54,) was sent in her stead. The Jefferson should, in my opinion, be replaced, as she was one of the most useful steam vessels of the coast survey.

Before proceeding with an account of the progress of the coast survey during the past year, I would again respectfully call the attention of the department to the fact that no acknowledgment, of the kind

which is most grateful to a military man, has yet been made to Captain A. A. Humphreys, of the corps of topographical engineers, for his devoted and most valuable services to the work. His claims are of the strongest kind for zealous, able, and effective service, and I trust, sir, will be urged by you upon the President.

I proceed to state the general progress of the work during the past year as briefly as the nature of the operations will permit, referring for details to the next division of my report, in which each operation is treated under its appropriate head, and with reference to the persons by whom it has been executed. The progress of the work proposed for the next fiscal year is stated, in a general way, in connexion with the estimates.

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.*—Nine parties have been employed in this section during the whole or part of the season; seven in land work and two in hydrography. Two of the topographical parties were double—that is, employed each two plane tables; and one of the hydrographic parties had three vessels, one of them a steam-vessel. The primary triangulation was extended to Cape Small Point, in Maine; and the astronomical and magnetic observations connected with it made at two stations. The reconnaissance was carried beyond the Penobscot. Special magnetic observations, for harbor charts, were made at three stations in Maine. The secondary triangulation was completed to Casco bay, and the reconnaissance carried over the bay. The topography of the vicinity of Chatham and Wellfleet, Massachusetts; of Cape Ann, from Beverly farms to the northeast point of the cape; and of Newburyport harbor, Massachusetts, was executed. The hydrography of the Nantucket shoals was continued. The hydrography of Muskeget channel was completed; off-shore soundings were made off Block island and Gay Head; the limits of soundings on Great Rip and Davis's bank extended; and the position of Fishing Rip determined. Tidal and current observations were made in Buzzard's bay and the Vineyard sound, and in the passages connecting them. Chatham harbor was examined; the hydrography of Salem, Newburyport, and Portsmouth (New Hampshire) harbors, and of their approaches, was completed. Tidal observations at Charlestown, Salem, and Newburyport, Massachusetts, and at Portsmouth, New Hampshire, have been made. Reports were made on light-houses, &c., at Naraguagus bay and the mouth of the Kennebec, Maine; in Boston harbor; off Chatham; in Holmes' Hole harbor, Massachusetts; and off Brenton's reef, Rhode Island. The difference of longitude of Bangor, Maine, and Cambridge observatory, Massachusetts, has been ascertained by telegraph, (November 25;) and Cambridge has been connected in the same way with a station of the British survey of Nova Scotia. A second chronometer expedition, for difference of longitude of Greenwich and Cambridge, has been in progress, and is nearly brought to a close.

The following maps and charts have been in progress, or published: Richmond's Island harbor, Maine; Salem harbor, Massachusetts, and its approaches; Nantucket shoals, new edition; and the general coast chart, Eastern series, No. 1.

SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and Delaware.*—The calls for work in this section, the most of which is essentially completed, have, as usual, been met by the employment of parties during a portion of the season when they could best be spared from other sections. The triangulation of the Hudson has been extended. Hydrography of verification has been made on the south side of Long Island, and at the entrance to the Connecticut river; additional off-shore work near the eastern end of Long Island has been done, and tides and currents have been observed for the off-shore chart. Sandy Hook has been re-surveyed to ascertain its changes; certain of the rocks and reefs in Hell Gate, near New York, have been minutely examined, to mark the changes by blasting; surveys of range lines for the main ship and Swash channels into New York harbor have been made. Tidal observations have been kept up at Governor's Island. Reports have been made on light-houses, beacons, buoys, &c., for Black Rock, Long Island sound, Gardiner's island, Sag Harbor, New York harbor, Fire island, Newark bay, and Passaic river.

The published charts and those in progress in this section are, Hart and City islands; south side of Long Island, eastern sheet; Hell Gate; off-shore chart, No. 1, from Gay Head to Cape Henlopen; mouth of Connecticut river; Long Island sound, western sheet; Sandy Hook sketch; Hell Gate rocks sketch. The atlas of Long Island sound requires but one harbor map to complete it, and that is well advanced.

SECTION III. In this section, which includes *the coast of part of Delaware, of Maryland, and part of Virginia*, ten parties have been at work. Astronomical observations have been made at two stations for latitude, azimuth, &c., completing the primary and astronomical work between the Washington observatory, Capitol, and the Chesapeake base. The primary triangulations have been extended down the Chesapeake, and preliminary determinations made to the capes. The secondary triangulation inside has advanced with the primary, and that outside has been carried to within about twenty miles of Cape Charles; next season these triangulations will be connected, verifying the secondary work, and the primary triangulation will be, probably, quite completed. The topography of both shores of the Chesapeake has advanced some forty-eight miles; the eastern shore to Rose Mary station, and the western to Wolf Trap. The topography on the outside has reached South Gargathy. The verification work of topography in the Patapsco and approaches, and on the eastern shore, has been continued. The hydrography has made excellent progress; the outside work has been extended twenty-six miles to South Gargathy, and the filling up inside, from Windmill point to Wolf Trap; the middle ground at the entrance to the Chesapeake has been sounded over. Tidal observations have been kept up at Old Point Comfort. Reports have been made on light-houses, &c., at Fishing battery (Chesapeake) and the Bodkin shoal (Patapsco.)

The map of Baltimore harbor and the Patapsco and the upper sheet of the Chesapeake have continued in the hands of the engraver. The drawings of the second sheet of the Chesapeake and of the outer coast have been commenced. The preliminary chart of the seacoast of Delaware, Maryland, and Virginia, has been extended southward so as to

give the Chincoteague shoals, employing the electrotpe process to make the additions without loss of the original plate. A sketch of the middle ground at the entrance of the Chesapeake has been prepared and published.

SECTION IV. *Coast of part of Virginia and of North Carolina.*—Six parties have been employed in this section during part of the season—three land and three hydrographic parties, one of the latter having a steam-vessel. Observations for difference of longitude were made by telegraph and chronometers between Washington and Forbes' Point. A reconnaissance was made for the extension of the primary triangulation over Pamlico sound, which included also an examination of Core sound. The secondary triangulation of Currituck sound was extended northward, nearly to the Virginia and North Carolina line. The triangulation and topography of the entrance to Cape Fear river and of its approaches were executed. The tertiary triangulation of the ocean shore was carried from Cape Hatteras to Ocracoke inlet. The topography of Beaufort harbor and its approaches was completed. The hydrography of Albemarle, Roanoke and Croatan sounds was completed, and that of Currituck sound carried to the limits of the land work. Oregon inlet was examined. The Frying-pan shoals, off Cape Fear entrance, were surveyed. The hydrography of Cape Fear entrance and its approaches was executed. The exploration of the Gulf Stream, in this and the next section, was continued. Examinations, under the light-house law, were made at Beacon island, Ocracoke inlet, (November,) the Hatteras shoals, and Cape Fear river.

The first sheet of the map of Albemarle sound has been in progress, and the second sheet is begun. The preliminary chart of Beaufort harbor, and sketches of Cape Fear entrance and of the Frying-pan shoals, have been prepared and published.

SECTION V. *Coast of South Carolina and Georgia.*—The work has made very good progress in this section. Charleston and Savannah have been connected with each other, and with the Seaton station, Washington, for difference of longitude. Astronomical observations at Charleston have been continued. The opening of the lines of the primary triangulation was continued, and two stations have been occupied; the secondary triangulation of North Edisto river, the Dawho, St. Helena sound, South Edisto and Ashepoo rivers, has been made, and the reconnaissance extended on one side of the base to the Stono. A preliminary triangulation of Savannah river entrance has been made. The topography of the shores of North Edisto harbor and river, and of the shores of the Savannah river, near the city and at the entrance, has been executed. The hydrography of Charleston harbor, and that of North Edisto harbor of refuge, has been completed. Tidal observations have been made at Charleston and Savannah.

The map of Charleston harbor has made considerable progress, and a tracing on a large scale has been sent to the Chamber of Commerce of the city. Sketches of North Edisto harbor of refuge, and of Savannah entrance and harbor, have been prepared and published. The sketch of Bull's Bay harbor of refuge has been republished.

SECTION VI. *Coast of Florida, and keys and reefs.*—Five parties have been employed during parts of the season on this coast. The base

lines have been prepared for final measurement; the reconnaissance has been extended. The triangulation has included Key Biscayne bay, the keys and sounds to Turkey key. The triangulation of Cedar keys and the vicinity of Crystal river has been commenced. The topography has embraced the Marquesas, Boca Grande and its vicinity, Bahia Honda, and Key Biscayne bay, and the main, to the limits of the triangulation. The hydrography of Key West and Boca Grande has been completed. A hydrographic reconnaissance has been made of Mosquito inlet, on the eastern coast of Florida, for placing buoys. Hourly tidal observations have been kept up at Key West.

The chart of Key West is in the hands of the engraver. Sketches of the reconnaissance of Cedar keys and Mosquito inlet have been prepared and published.

SECTION VIII. *Coast of Alabama, Mississippi, and Louisiana.*—The secondary triangulation has included work of revision, and has been extended westward, signals being placed in Lake Borgne and the Rigolets. Biloxi and St. Louis bays have been triangulated. The topography has advanced along Mississippi sound from West Pascagoula river, to include Biloxi bay, and has included part of Pass Christian. The hydrography has been extended outside east and west of Mobile entrance; has included Bon Secours bay, (Mobile bay,) Pass Christian, and a reconnaissance of the Southwest pass and the Pass à l'Outre of the mouths of the Mississippi. Hourly tidal observations have been made at Fort Morgan, Mobile entrance.

The chart of Mobile entrance has been published; the preliminary chart of Mobile bay has been prepared and published, and the drawing of the two sheets of the finished chart of the bay has been nearly completed. Sketches of Horn Island pass, Pass Christian, and the delta of the Mississippi, have been prepared and published.

SECTION IX. *Coast of Texas.*—The primary triangulation has been extended westward to the set of stations preceding the Brazos, and the secondary triangulation somewhat further. The topography of Galveston bay has been completed, including Turtle bay and the entrance of the San Jacinto and Trinity rivers, and East and West bays, to the limits of last year's triangulation. The hydrography of Galveston entrance has been completed, and that of the approaches nearly so. Hourly tidal observations have been made during part of the season at Galveston. The light-house sites in Galveston Upper and Lower bays, and at Aransas pass, have been examined and reported upon.

The drawing of the chart of Galveston entrance is in progress. Sketches of the bay and of Aransas pass, for light-house purposes, have been prepared and published.

SECTIONS X AND XI. *Coast of California and Oregon.*—The appropriation permitted merely the employment of the same force as last year; namely, four parties. Although the hydrography has been materially impeded by the untoward loss of the steamer Jefferson, already alluded to, the efforts made to keep the work moving onward have been attended with success. The geographical positions of Point Conception, Point Pinos (Monterey,) Point Loma (San Diego,) and Cape Hancock, or Disappointment, have been determined. Magnetic observations have been made at the same points. The triangulation of part

of San Francisco bay and of San Diego harbor has been made. Planetable surveys for sites of light-houses have been made in San Francisco bay and its approaches, at Monterey, Point Conception, San Diego, and Cape Hancock, or Disappointment, and its vicinity, including Cape Adams. Surveys for the joint commission for naval and military defences have been made at Mare island, near Vallejo, and on both sides of the entrance to San Francisco bay. A full hydrographic reconnaissance has been made of Columbia river from its entrance to a point above Astoria, of Humboldt harbor and river, and of Trinidad bay; and a general hydrographic reconnaissance is in progress from Monterey to San Diego, as supplementary to that of last year from Columbia river to Monterey. Buoys have been sent to Columbia river by direction of the Treasury Department, to be placed by the coast survey party there. A report on a light-house site at Humboldt harbor is received, and one at Umqua river has been directed. Tidal observations are making near San Francisco.

The chart of Columbia river has been engraved, and will be published after making provision for the introduction of reported recent changes, if found to be of importance. Sketches of the reconnaissance of Humboldt harbor, Trinidad bay, San Francisco entrance and bay, San Diego harbor, Cape Disappointment, Point Conception, Point Pinos, and Point Loma, have been engraved and published. The work in the field is in vigorous activity, and the arrangements in the office for publishing are most thorough and effective.

Besides the work stated in the several sections, the computation of the field work, the registry and assemblage of it, the reduction of the land work and hydrography in the office, have kept pace with the out-of-door operations. Fifteen maps have been electrotyped. Sixty-three sketches, including those showing the progress of the work, have been prepared and engraved, to accompany this report.

The list of geographical positions from the preliminary computations of the survey, with the necessary maps to render it available to geographers, surveyors, and others, has been prepared with much labor, and is now appended to this report. (Appendix No. 12.)

In the estimates for the next fiscal year, I provide for the continuation of the work on the same scale which has been heretofore approved by the Executive and Congress; expressing, however, my conviction, which has been before stated, that the appropriations for the Florida reefs and keys should be increased, for at least a few years, to sixty thousand dollars, so as to enable the work to be rapidly pushed in that quarter.

The publication of the observations made in the survey, to which I have also, from time to time, called attention, is very desirable. It will secure them from all possibility of loss; can be done better, more quickly, more accurately, with greater knowledge of all details, while the work is in progress, than after it has all closed. The publication of the observations would tend to facilitate the progress of the work itself, and furnish means of estimating the relative value of different processes used in it. It has been warmly recommended by one of the first scientific bodies in the country, the American Philosophical Society. The cost of publishing the data from the work, and many results which

we are now cramped for means to give to the public, would not exceed thirty thousand dollars for the first year, and might be less afterwards. They should be published in a form suited to scientific observations, and creditable to the country, and under close supervision at the Coast Survey office.

I am satisfied that it will be best for a few years to give the full appropriation asked last year for the western coast, that we may render the facilities which the great and rapidly increasing commerce demands. The navigation by steam renders the necessity for a knowledge of the coast more than ever important, as steam-vessels run a direct course, keeping near the land, and stopping from harbor to harbor, as commerce requires. Until we have the necessary information of a general kind, we ought to press the survey in that quarter. The results, even under the disadvantageous circumstances of the past year, show what may be done by zeal and industry, furnished with adequate means. The addition of another party there is very desirable.

In making these estimates, I suppose the usual aid derived under the law from the War and Navy Departments. The unusual calls during the past year for payment of transportation of naval officers on first joining the work, ordered often, as they are, from distant points, and for clerks or draughtsmen for the hydrographic parties when ashore, have pressed heavily on our limited means, which did not hold out to the end of the fiscal year. I have provided against the recurrence of this contingency by addition to the estimates for the coast of the Atlantic and Gulf of Mexico, which, though small, is necessary to prevent the cutting off of part of the anticipated operations.

ESTIMATE FOR THE FISCAL YEAR 1852-'53.

General expenses for all the sections, namely: rent, fuel, postage; materials for drawing, engraving and printing; carpenter's work and materials; instrument maker's work and materials; blank-books, stationery, printing and ruling forms; binding; transportation of instruments, maps and charts, and miscellaneous office expenses; purchase of new instruments, books, maps, and charts..... \$16,000

SECTION I. Coast of *Maine, New Hampshire, Massachusetts, and Rhode Island. Field-work.*—To extend the primary triangulation in *Maine*, and make the reconnaissance and astronomical and magnetic observations connected with it; to extend the secondary triangulation over *Casco bay*, (*Portland*), and to determine the heights of the stations between *Portsmouth (New Hampshire)* and *Portland*; to complete the topography of *Newburyport* harbor; to commence that of the coast between *Portsmouth* and *Portland*, and of *Portland* harbor; to complete the topography of *Cape Ann*; to continue the hydrography of the *Nantucket* shoals, and of the ocean near *Nantucket*; to commence that for off-shore chart No. 2; to complete that of *Chatham, Gloucester, and Annis Squam* harbors, and to commence those of *York, Saco, and Kennebunk*; to continue the observations of tides and currents in *Martha's Vineyard* and *Nantucket* sounds,

and to take the views required for the general coast chart No. 2. *Office-work*.—To make the reductions and computations for the section; to complete the drawing of coast chart No. 3, from *Cape Pogue* to *Chatham* light, the drawing of *Salem*, *Newburyport* and *Portsmouth* harbor charts, and to commence those of *Chatham*, *Gloucester*, *Annis Squam*, and *Portland* harbors; to continue the engraving of *Boston* harbor chart; to complete those of *Newburyport*, *Salem* and *Portsmouth*,—will require

\$36,000

SECTION II. Coast of *New Jersey*, *Pennsylvania* and *Delaware*.

To continue the triangulation and hydrography of the *Hudson*; to make such work of verification as may be required; to complete the observations of tides and currents for off-shore chart No. 1; to complete the engraving of south side of *Long Island*, middle sheet; to complete the engraving of *Connecticut* river entrance,—will require

7,000

SECTION III. Coast of *Delaware*, *Maryland*, and *Virginia*.

Field-work.—To complete the triangulation of the shores of the *Chesapeake*, and of adjacent bays and roadsteads in *Virginia*, of the outer shore to the capes of *Virginia*; to make the astronomical and magnetic observations required, the secondary triangulation of part of the *Potomac* or of *James* river; to continue the topography of the shores of the *Chesapeake* to *York* river on the western shore, and *Tazewell's* on the eastern shore of *Virginia*, and of the outer shore of the peninsula to *Rogue's* island; to continue the hydrography of the outside to *Rogue's* island, and of the *Chesapeake* to *York* river, nearly. *Office-work*.—To make the computations for the section; to complete the drawing of a third sheet of the *Chesapeake* bay, and to commence the second series; to complete a sheet of the general coast chart of the outer coast; to complete the engraving of the first sheet of *Chesapeake* bay, and of a general chart of the upper section of the bay,—will require

33,000

SECTION IV. Coast of *North Carolina*.—To make the reconnaissance required in this and the next section; to continue the primary triangulation over *Pamlico* sound; the secondary triangulation northward, nearly to its connexion with that of the *Chesapeake*; to complete the tertiary triangulation of *Core* sound, and connect it with *Beaufort* harbor; to continue the triangulation of the *Cape Fear* river; to complete the topography of the ocean shore from *Hatteras* to *Ocracoke*, and of *Currituck* sound and the ocean shore northward, to beyond the *Virginia* and *North Carolina* line; to complete the hydrography of *Currituck* sound to the limits of the triangulation; to continue that of *Pamlico* sound and *Ocracoke* inlet; to continue that of the entire coast between *Cape Hatteras* and *Cape Fear*; to continue that of the *Cape Fear* river to *Wilmington*, (N. C.); to make the observations in the *Gulf Stream* in this section. *Office-work*.—To complete the drawing of the chart of *Albemarle*,

Croatan, Roanoke, and part of Currituck sounds; to continue the engraving of the first sheet; to draw and engrave the chart of Cape Fear entrance, of the Fryingpan shoals, &c.,—
will require

\$25,000

SECTION V. *Coast of South Carolina and Georgia. Field work.*—To continue the secondary triangulation from its present limit eastward to *Charleston*, and westward from *Beaufort*, South Carolina; to complete the triangulation of the *Savannah* entrance and river, and of *Calibogue* sound; to continue the primary triangulation eastward to *Charleston*; to complete the topography of *Kiawah*, *James's* and *John's* islands, and of the shores of *Stono* and *Ashley* rivers; to complete the hydrography of *St. Helena* and *Calibogue* sounds, and to commence that of the ocean coast between *Charleston* harbor and *Savannah* entrance; to make the *Gulf Stream* exploration in this section; to make tidal observations at *Charleston* and *Savannah* entrance. *Office work.*—To make the computations required for the section; to complete the drawing of *Savannah* river, the engraving of the chart of *Charleston* harbor, and of *Savannah* harbor, entrance, and river, and of *North Edisto* harbor of refuge,—will require

23,000

SECTION VI. *Reefs, keys and coast of Florida.*—See estimate for special appropriation, as provided for the three years last past.

SECTION VIII. *Coast of Alabama, Mississippi, and Louisiana.*—To continue the main and secondary triangulation southward from the *Chandeleur* islands towards the mouths of the *Mississippi*; to complete the connexion of *Washington*, *Mobile* and *New Orleans*, for difference of longitude by telegraph; and to make a triangulation of the principal entrances of the Delta of the *Mississippi*; to continue the topography of the shores of *Pontchartrain* and of the *Chandeleur* islands and main; to continue the hydrography of *Mississippi* sound, and of *Louisiana* bay; to make tidal observations at several points on the coast of *Louisiana*. *Office work.*—To make the computations and reductions required by the field work of the section; to complete the drawings of the two eastern sheets of the map from *Mobile* entrance to the mouths of the *Mississippi*; the engraving of one sheet of *Mobile* bay, and the commencement of a second

25,000

SECTION IX. *Coast of Texas.*—To continue the main and secondary triangulation, to include part of *Espiritu Santo* bay; to continue the topography westward, to include *Matagorda* bay; to continue the hydrography of the outer coast and of the entrances, and *Matagorda* bay, and the tidal observations at points of the coast. *Office work.*—To complete the drawing of the map of *Galveston* upper and lower bays, and to commence the first sheet of the general coast chart of *Texas*; to complete the engraving of the chart of *Galveston* entrance, and to commence that of *Galveston*

bay; to make the computations and reductions required for the work of the section,—will require..... \$21,000

SECTIONS X and XI. Western coast, *California* and *Oregon*.—

See estimate provided for, as last year, by special appropriation.

Total, exclusive of Florida reefs and keys, and of the western coast..... 186,000

SECTION VI. To continue the survey of the *Florida* coast, reef, and keys. *Field work*.—To complete the triangulation of the *Walker* keys; to continue that of the reef from *Key Rodriguez* southward and westward to *Key Vacas*; to continue the secondary triangulation of the western coast of *Florida* from *Crystal* river southward; to complete the topography of the keys to the limits of the triangulation; to continue the hydrography of the outer coast and reef, from *Ajax* reef southward. *Office work*.—To make the necessary computations and reductions; to complete the drawing of *Boca Grande* passage, and *Bahia Honda*, and the engraving of the chart of *Key West* harbor and the approaches; and sketches of the *Boca Grande* passage and *Bahia Honda*—will require \$30,000

SECTIONS X and XI. To continue the survey of the western coast, *Oregon* and *California*. *Field work*.—To determine the geographical positions, absolute and relative, of the most important capes and headlands in *California* and *Oregon*; to complete the triangulation of *San Francisco* and *San Pablo* bays, &c., and of *Santa Barbara* sound; to complete those of the several harbors already examined; to continue that of the *Columbia* river, and of *Puget's* sound; to complete the topography for the harbor charts already commenced, and for the sites of light-houses; to complete the hydrography of the *Columbia* river; to continue that of *San Francisco* bay, of *Monterey*, *Santa Barbara*, &c.; to complete the general examination of the harbors of the coast and to revise the general reconnaissance of the coast. *Office work*.—To make the computations and reductions; to complete the drawings and engravings for the sites of light-houses, and of the examinations of harbors; to continue those of *San Francisco* bay, *Monterey*, and the revised reconnaissance; to provide for the drawing and engraving of sketches received; for the engraving of the revised general coast reconnaissance; of the *Columbia* river survey; of *Santa Barbara* sound, &c.,—will require..... 150,000

The appropriation for the western coast will include the necessary repairs and expenses of a steam-vessel, and will add one party to those operating in that quarter.

The appropriation for the coast of the Atlantic and Gulf of Mexico in 1850–51, was..... 186,000

For the Florida reefs, keys, and coast..... 30,000

For the western coast, including the cost of a steam-vessel.. 190,000

For the next year—the present fiscal year—the appropriations were severally \$180,000, \$30,000, and \$100,000. I am satisfied, from experience, that the sums now asked are as small as, with the most economical administration of the survey, the work marked out can be executed for; requiring a close and constant care to make them give these results. The plan of operation is in a degree deranged, and the relative parts make a progress not adapted to each other, when the amounts are lessened; besides which, a portion of the work is necessarily cut off, and the survey makes slow progress. I am of opinion that true economy in such a work is to be found by enlarging the operations, thus increasing the division of labor. The work being of a temporary character, the enlargement of its expenditures is more than made up to the treasury by its less duration.

I proceed, next, to give a more particular account of the operations on the several sections of the coast, derived from the reports of the assistants and others employed; prefacing the more detailed statements with remarks on the progress of the section, and on the more interesting general results. The incidental notices of the office-work which thus occur in connexion with the sections, are followed by a complete detail of the progress in its various departments.

A table of occupation of the field and hydrographic parties is given in the Appendix, (No. 1,) showing their distribution during the different seasons appropriate to surveying different parts of the coast.

The light-house work executed in the different sections is stated in the general table, (Appendix, No. 15,) and more in detail under the head of each geographical section of the coast.

In the Appendix to this report, Nos. 13 to 14 *bis*, inclusive, will be found the instructions of the Treasury Department, and the general correspondence on the subject of light-houses, &c.; special reports being elsewhere given in the Appendix, in connexion with the section to which they refer. The Appendix No. 16 contains a circular to the chiefs of hydrographic parties, referring to a communication from the secretary of the Light-house Board, asking suggestions for the improvement and extension of the present light-house establishment, and extracts from the replies.

SECTION I.—FROM PASSAMAQUODDY BAY TO POINT JUDITH, INCLUDING THE COAST OF MAINE, NEW HAMPSHIRE, MASSACHUSETTS, AND RHODE ISLAND.—(Sketch A.)

The new appropriation having been available from the very beginning of the fiscal year, the work in this section has made very good progress. Two triangulation, three topographical, and two hydrographic parties, were at work during nearly the whole of the season; one of the triangulation parties making also the astronomical and magnetic observations connected with the primary work; two of the topographical parties using each two plane tables; and one of the hydrographic parties having, for the greater part of the time, three vessels—one of them a steam-vessel. The primary triangulation was extended to Cape Small Point, at the mouth of the Kennebec, and the reconnaissance for it beyond the Penobscot. The secondary triangulation was

completed to Portland. The topography of Cape Cod, Cape Ann, and Newburyport harbor, in Massachusetts, was nearly completed. The hydrography of Nantucket shoals was continued; that of Salem, Chatham, Portsmouth, and Newburyport harbors completed; off-shore work off Block island and Gay Head was executed; and tides and currents were observed near the Elizabeth islands, in the Vineyard sound and Buzzard's bay, at Holmes' Hole, Salem, Newburyport, and Portsmouth. The permanent tidal station at Charlestown, Massachusetts, has been kept up, and observations for several lunations have been made in Salem, Portsmouth, and Newburyport harbors. The office-work has made corresponding progress.

Accompanying this report (sketch A, No. 3) is a current chart, showing the nature and results of observations of previous years in the harbor of Boston.

The preliminary chart of Richmond's Island harbor, issued to meet the wants of the Committee on Commerce, has given place to a more complete map.

During the great gale of April last, the violence of which was especially felt on the coast of Massachusetts, an opening was made through Chatham beach, (see sketch A,) giving a more direct and deeper entrance to the harbor of Chatham than had previously, at least of late years, existed. This attracted much attention, and hopes were entertained that a harbor of refuge might thus be obtained at a point where one was much needed. I incorporated in the instructions of the season directions to examine Chatham harbor, and if the bar and entrance were found in a moderately permanent condition, to make a complete survey of it. The topographical party of Assistant J. B. Glück was instructed to complete, without delay, the shore line; and Lieutenant Commanding Woodhull to take some convenient opportunity, towards the close of his operations in the Vineyard sound, to make the desired examination. This was promptly executed. The greatest depth which he found could be carried over the bars, at *high* water, was eleven feet; the rise and fall of the tide being about four and a half feet. There is deep water—in one spot twenty-two feet at low water—near the village of Chatham. The changes from week to week in the *outer bar*, he was satisfied, were such that a chart could not be made which would be of service to navigation. He accordingly recommended the postponement of the survey until a more permanent condition was reached; making, meanwhile, quite a careful examination, which has been plotted, and the chart representing which has been placed on file in the office, where it may be consulted by, or copied for, those who are especially interested in the matter.

The occupation of some twelve more stations will complete the primary triangulation to the northeastern boundary. The reasons which render it more expedient to employ a party only during part of the season for this purpose, have been frequently stated. The primary triangulation is still in advance of the secondary, though, in consequence of the desirableness of prompt surveys of some of the harbors in the more eastern part of the section, that operation has been pushed well forward.

The difficult and comparatively expensive hydrography of the Nan-

tucket shoals, has delayed the hydrography beyond my calculations. The transfer of one of the southern hydrographic parties to this section formed part of my plan for the past season, which was interrupted by causes beyond my control, and which it is not necessary here to state. The plan is only deferred, not given up. The examination for a base of verification will be made next season, or in the following one; and, should a suitable one be found, the triangulation will be directed in reference to a junction with it.

The tides, and currents resulting from them, in the passages between the Elizabeth islands are altogether peculiar, and require close investigation. On one side of the islands the rise and fall belongs to Buzzard's bay; and on the other side to the Vineyard sound. The Buzzard's bay tide is propagated through the entrance between Cuttyhunk and Saghkonnnet Point. (See sketch A.) The two chief passages used by vessels between the Vineyard sound and Buzzard's bay are Wood's Hole and Quicks' Hole. The plan which I sketched for determining the facts in regard to the tides was the establishment of three tide-gauges, to be observed during the same period on the north side of the Elizabeth islands at Wood's Hole, Kettle cove, and Quicks' Hole; and on the south side at Wood's Hole, Tarpaulin cove, and Quicks' Hole. These observations would give the corresponding phenomena and their progress between the two passages, and, being completed satisfactorily, the gauges from Kettle and Tarpaulin coves were to be removed to points nearly midway, or, better, at or near the point of meeting of the tides from the bay and sound, between the two gauges in Wood's and the two in Quicks' Hole, so as to determine the relation of the movement in these passages. This plan has been satisfactorily carried out during the present season, except that three days of simultaneous hourly observations, which I considered essential to its completeness, could not be made on account of the boisterous character of the weather.

During the season I had repeated conferences with the chiefs of parties in this section when the diversified operations required it, but made no special inspection. The inspection of a portion of the operations was made by Major I. I. Stevens, of the corps of engineers, assistant in charge of the office.

In 1849, a special expedition for the determination of the difference of longitude between the coast survey stations and European observatories was organized and reported upon. During the following year the reduction of the observations was made, so as to draw upon the experience of that operation for improvement in a subsequent one. During the past season the second trial has been made, the general results of which will be stated in their place from the report of Professor W. C. Bond, director of the Cambridge observatory, by whom, in concert with Mr. Hartnup, director of the Liverpool observatory, the work has been executed.

Arrangements have also been made, through Professor Bond, for connecting the coast survey of the United States with the surveys making by the British government in Nova Scotia. The occasion will be taken to obtain the longitude, by telegraph, of Bangor, in Maine, an important point in every respect, while facilitating the connexion of Cambridge and Halifax. The thanks of the Survey are due to H. O. Alden, esq.,

the president of the Maine Telegraph Company, for assistance rendered in these operations. (See Appendix, No. 18.)

The appropriations for light-houses, beacons, buoys, &c., embraced in the bill approved March 3, 1851, for localities within this section, were the following:

"*Maine*.—1. For buoys on White's and Thom's ledges, and on Pond Island reef, at the mouth of the Kennebec river, three hundred dollars.

"2. For a light-house on Pond island, at the entrance of Narraguagus bay, four thousand dollars.

"*Massachusetts*.—3. For a light-boat on the Shovelful shoals, off Chatham, twelve thousand five hundred dollars.

"4. For eleven buoys in the channel to Commercial point and Neponset river, in Dorchester, one thousand dollars.

"5. For a light-house at the head of Holmes' Hole harbor, three thousand five hundred dollars.

"6. For a beacon on Fawn bar, near Deer island, Boston harbor, two thousand five hundred dollars.

"7. For two iron spindles on the northeast ledge of the Graves, and on Harding's ledge, Boston harbor, two thousand dollars.

"*Rhode Island*.—8. For a light-boat off Brenton's reef, fifteen thousand dollars."

Examinations of all these were required, under the law, by the Fifth Auditor, and were made, according to the instructions from the Treasury Department, under my direction. My reports will be found in the Appendix, (Nos. 19, 20, 21, and 22,) accompanied by those of the assistants of the survey to whom the examinations were referred, (Lieutenants Commanding Charles H. McBlair and Maxwell Woodhull, United States navy,) which contain all the details necessary to an understanding of the subject. In every case a thorough examination of the localities was made, wherever the coast survey extended, by the aid of its charts, and the reports state fully the requirements of navigation in reference to the objects embraced in the bill.

The buoys at the mouth of the Kennebec (No. 1) were recommended to be immediately placed, (July 28.) The light-house on Pond island, Narraguagus bay, (No. 2,) was also recommended to be erected, to contain a revolving light. A light-boat on the southeast extremity of Shovelful shoals, off Chatham, (No. 3;) a beacon on Fawn bar, near Deer island, (No. 6;) and two iron spindles on the Graves and Harding's ledges, Boston harbor, (No. 7,) and the light-boat off Brenton's reef, (No. 8)—were recommended to be placed. The buoys in the Neponset river (No. 4) had already been reported upon favorably from the office of the Coast Survey. Instead of the light-house at the head of Holmes' Hole, three small beacon-lights, (technically called "bug-lights,") for ranges, were recommended, and their positions indicated on a chart. It was supposed that the three beacon-lights could be put up for the amount of the appropriation for a single light-house.

A fog-whistle for the light-house on Petit Menan island, instead of the present fog-bell, and a buoy on Thomas' reef, near Thom's reef, at the entrance of the Kennebec—objects for which an appropriation had been made—were reported as desirable.

The reports of the examining officers not only show that there are

good reasons for establishing the facilities to navigation provided in the act of Congress for this section of the coast, but give collateral information and facts of very considerable interest, adding much to our knowledge of the coast.

In a communication, in reply to questions from the Light-house Board, Lieutenant Commanding McBlair presents the following subjects for consideration: 1. The substitution of a light-house on the ledge called Sow-and-Pigs, off Cuttyhunk, at the entrance to Buzzard's bay, for the light-boat now placed there, and the light-house now existing on the island of Cuttyhunk; (see sketch A.) 2. The placing of a floating beacon on Davis' New South shoal; (see sketch A, No. 2.) This shoal lies near one of the most frequented parts of the ocean, and has occasioned some very disastrous wrecks. It has as little as eight feet water upon it, is swept by very strong tidal currents, and, during the summer months, is almost constantly hidden by fogs. It was designed at one time to erect a beacon upon it; but the great difficulties of the undertaking, arising from the character of the climate and the distance of the nearest port, seem to be regarded as insuperable. It is, however, indispensable to the safety of passing vessels that it should be marked in as distinct a manner as circumstances will admit. 3. A buoy-boat on the Great Rip, one of the most extensive of the Nantucket shoals. 4. A buoy-boat on the sand shoal lying to the eastward of the northern end of Bass Rip. 5. A spar-buoy on the sand-spit extending from Fox's Point, Nashawena island, at the southern entrance of Quicks' Hole; (see sketch A.) 6. A wooden beacon, (to be painted black,) on Long island, Boston harbor, placed so as to range with the northeast end of Spectacle island, for the safe navigation of the main ship channel; (see sketch A;) recommended also by Lieutenant Commanding Charles H. Davis, in 1847. 7. A similar beacon on the southeast part of Long island, Boston harbor, to range with Nix's Mate, and to facilitate the passage through the Broad Sound channel. 8. A buoy-boat on the southwest end of Billingsgate shoal, Manchester bay, and two spar-buoys on the southern edge of the shoal, planted at regular intervals between the boat and Billingsgate island. 9. A spar-buoy on Bibb Rock, southward and westward of Wellfleet harbor. 10. Changes in the position of the lights at Chatham, to adapt them to the changes in the coast there.

These recommendations are fully concurred in, as his field of work has extended, by Lieutenant Commanding Swartwout, who commanded the brig Washington, attached to Lieutenant Commanding McBlair's party.

In connexion with this subject I present the following extract from a report (November, 1850) of Lieutenant Commanding Maffitt, United States navy, assistant in the coast survey:

"I examined a rock in the main ship channel, Boston harbor, near the buoy of the Lower Middle, upon which the British mail steamship Cambria struck, and found it to be identical with a rock already found on the Coast Survey chart to be seen in the work of 1847."

Reconnaissance.—It has been necessary merely to extend the reconnaissance in this section, during the present season, to one range of stations beyond the Penobscot, in order to prevent possible interference with the primary triangulation of the next season. This has been done

by assistant C. O. Boutelle, and the result is shown on sketch A. The fact that, if necessary to the work, either from the position of the final base of verification in this section or other cause, a point can be found on the Ebeeme mountains readily connected with the coast, has been ascertained. Mr. Boutelle also established the station on Ragged mountain, (Camden mountains.) He was accompanied during his reconnaissance by Major Prince, United States army, assistant in the coast survey.

Mr. Boutelle made, also, a reconnaissance for the main chain of secondary triangles over Casco bay in the course of the season.

Primary triangulation, astronomical observations, &c.—The party under my immediate charge was transferred to this section in July, and between the second of that month and the fifth of November two stations were occupied for geodetic and astronomical work, and one for astronomical observations. The magnetic variation, dip, and intensity, were measured at two of the stations; vertical angles were measured for height at the three; and a meteorological register was kept during the progress of the other observations. The area of the work, estimated in the usual way, was 2,402 square miles. I was assisted in the measurement of horizontal and vertical angles, and the azimuth determinations, by Lieutenant W. P. Trowbridge, of the corps of engineers, and the observations for time and latitude were made under my immediate direction by sub-assistant George W. Dean.

At Mount Pleasant station, (Oxford county, Maine,) 22 horizontal angles of the primary triangulation were measured by 1,300 observations, with the thirty-inch theodolite of Troughton and Simms, (C. S. No. 1,) 130 vertical angles for difference of height, with the micrometer of this instrument, and thirty for absolute elevation, by a six-inch Gambey theodolite, (C. S. No. 34,) sets of six repetitions being employed. A signal was placed upon the highest point of Mount Washington, and observed upon whenever the atmosphere was clear.

The azimuths were measured by seventy-two observations, in seven sets, on Polaris, near the upper and lower culmination, the method, referred to in my report of last year, of corresponding azimuths before and after culmination being used. The star was referred to a mark distant about three-quarters of a mile, nearly in a line to the Blue Mountain station, between which and the mark the angle was measured by the micrometer. The observations were made with the thirty-inch theodolite, (C. S. No. 1,) and in five positions of the instrument.

The latitude was determined by Talcott's method, with a zenith telescope by Würdeman, (C. S. No. 5,) which has been already referred to, having a focal length of forty-nine inches, an aperture of three and a half inches, and used with a magnifying power of six hundred. Two hundred and thirty-six observations were made upon forty-four pairs of stars, arranged from eighty-one stars taken from the Greenwich catalogue; using, also, as many as practicable of the stars of which the places have been determined by the Coast Survey zenith sector. The usual determination of the value of the micrometer and level divisions of the instrument were made. The longest and shortest sides of the primary triangulation of the season were eighty-four and twenty-two miles, respectively.

Some of the lines from Mount Pleasant having been obstructed by the erection of a new house upon the mountain, a second station point was selected by Mr. Boutelle, about fifty-seven feet from the first, and in the line from Sebattis to the original station. This distance was very carefully measured twice by a standard metre-bar placed on a wooden frame, the two measurements scarcely differing. They were made by myself, assisted by Lieutenant Trowbridge and Mr. Dean.

I was indebted for assistance, in posting heliotropers and other arrangements, to assistant C. O. Boutelle and Mr. Fairfield. Mr. Boutelle also observed for me during a brief absence, on duty, from Mount Pleasant.

At Ossipee station, (York county, Maine,) 15 horizontal angles were measured by 1,470 observations, with theodolite No. 1, and 128 vertical angles for height, with its micrometer, and with the six-inch Gambey theodolite, before referred to.

At Cape Small station, (Lincoln county, Maine,) eleven observations for azimuth were made on seven different days. The observations were made on Polaris—six at upper culmination, four at eastern elongation, and one at western elongation.

The observations for time and latitude, made under my direction by sub-assistant Geo. W. Dean, were as follows:

At Mount Pleasant station, 94 observations for time, upon 16 stars, paired as high and low stars, with transit C. S. No. 6, (Troughton and Simms,)—the equatorial intervals of the wires of this instrument were determined by 47 observations upon six stars. For latitude, 236 observations were made with zenith telescope C. S. No. 5, (Würdeman,) upon 44 sets of stars arranged from 81 different stars selected from the Greenwich twelve-year catalogue. When the places of the stars have been determined with the zenith sector as well as at Greenwich, equal weight has been given to each determination. For the value of the micrometer, 50 observations were made upon Polaris at eastern elongation, and 79 observations upon a collimator for value of level scale.

At Cape Small station, with the same instruments, 104 observations for time were made upon 14 stars, and 243 observations for latitude upon 40 sets arranged from 79 different stars. For the value of the micrometer of the zenith telescope, 91 observations were made upon Polaris at eastern elongation; for value of level of same instrument, 48 observations upon a collimator, in the usual manner.

The time of beginning and end of the solar eclipse of July 27, 1851, were observed at Mount Pleasant station.

The magnetic observations made by sub-assistant Dean, assisted by Mr. Edward Goodfellow, at Mount Pleasant and Cape Small, were as follows: For declination, 132 observations on 9 different days; for horizontal intensity, 7 sets on 7 days; and for dip, 5 sets on 5 days. The declination and intensity were observed with the portable declinometer of Gauss & Weber, as arranged by Professor Lloyd and Colonel Sabine, (Jones, No. 22, C. S. No. 1,) and the dip with a circle of eight inches, belonging to the Smithsonian Institution.

The meteorological observations at these stations, made by Mr. Edward Goodfellow and Mr. B. F. West, consisted of 328 readings for

temperature of the air, for moisture, (wet bulb thermometer,) for pressure, (Alexander barometer,) and miscellaneous.

Additional observations were made eight times a day, on eight days, of the barometer, thermometer, &c., by request of Professor Arnold Guyot, of Cambridge, to correspond with his observations for height in the White mountains and the adjacent country. The height of the surface plane, as shown by clouds resting on the Presidents' range, was also noted from Mount Pleasant at his suggestion. These observations were made by Mr. Edward Goodfellow and Mr. B. F. West.

The following magnetic observations were made by assistant J. E. Hilgard, between the 15th and 31st of August. The localities indicate the charts to which the results of the variation will be applied.

Stations.	Declination.	Dip.	Intensity.
Bramhall's Hill, in Portland.....	3 days	4 sets	2 sets.
Kennebunk Port.....	3 "	3 "	2 "
Cape Neddock.....	3 "	3 "	2 "

These observations complete the series as far east as Portland harbor.

The instruments used were the declinometer No. 20, by Jones, and a nine-inch dip-circle by Barrow, with reading microscopes and verniers.

Assistant S. C. Walker has collected, for convenient reference and comparison, all the results obtained by the transportation of chronometers for the differences of longitude of Harvard and Liverpool observatories. The data are those reported by William Cranch Bond, esq., director of the Harvard observatory, for the Coast Survey, and those of the special chronometer expedition of 1849-50, undertaken by the Coast Survey, and under Mr. Bond's immediate direction. They are classified as follows:

1. Results by chronometers making one *western* voyage, between Boston and Liverpool, and on trial for the government, or for the commercial marine.

2. Results by chronometers used in several western voyages prior to 1849.

3. Results of the western voyages in the special chronometer expedition of 1849-50 (also reported by Professor Bond) with ordinary chronometers.

4. As class 3, but with selected chronometers.

5. Results of eastern voyages, otherwise as class 3.

6. As class 5, but with selected chronometers.

The indiscriminate mean of the results by these six classes gives for the longitude of Cambridge, west of Liverpool, 4 hours 44 minutes 39.96 seconds.

The services of W. C. Bond, esq., director of the Cambridge observatory, have been rendered to the Coast Survey in various astronomical observations, telegraphic and chronometer operations, the nature and progress of which may be gathered from the following extracts from his report:

"I have to report the observation of thirty moon culminations, a portion of which have been forwarded to the Coast Survey office at Washington, corresponding to similar observations made at Point Pinos and San Diego, California, by Coast Survey assistant Davidson.

"Twelve occultations of stars by the moon and one solar eclipse have been observed at this place, the latter by four observers, each being furnished with separate chronometers and instruments. The telescopes used were of different kinds and powers, according to the suggestion of Mr. Airy, in his paper of instructions relative to this eclipse.

"The results which have been obtained by means of the electromagnetic apparatus for recording astronomical observations are quite satisfactory. This method of adapting the electric current to the wants of the astronomer, and which has grown up under the fostering care of the Coast Survey, is purely *American*, and is acknowledged as such in Europe.

"The complete apparatus designed and made by ourselves for the coast survey, after having been tested at this observatory during several months, was, with your consent, taken to England, and put in operation, in May last, at the Royal Astronomical Society's rooms in Somerset House, in London, where it was examined and tried by those who felt an interest in such matters, this being considered the most effectual course to pursue in order to convince astronomers of the superior accuracy, expedition, and convenience of this method. At the request of several distinguished scientific gentlemen, the coast survey apparatus was transferred to the rooms of the British Scientific Association, at Ipswich; and, subsequently, we were urged to have it put up in the department assigned to American inventions at the great Exhibition in Hyde Park. As a proof of the estimation in which this is held, I may be allowed to mention that the Astronomer Royal is now engaged in introducing the 'American' method of recording into the observatory at Greenwich; and we hear, through the newspapers, that the council-medal of the great Exhibition has been awarded to our apparatus: it had previously obtained the gold medal of the Massachusetts Mechanical Association. We have nearly completed a similar apparatus for our own use at this observatory, in order more particularly to observe moon culminations, in connexion with your apparatus, when it shall have been put in operation at the Seaton station, in Washington.

"The chronometer expedition, which you put under my care, for determining the differences of longitude of the observatories of Greenwich, Liverpool, and Cambridge, closed for the season—so far as the transfer of chronometers was concerned—on the arrival of the steamer *America*, on the 17th instant. We have, this year, the data given for differences of longitude by one hundred and ninety chronometers; these instruments are now on trial for their subsequent rates, and will be subjected, for temperature corrections, to the cold of the approaching winter.

"According to your instructions, I have made preliminary arrangements for the connexion in longitude, by means of the electric telegraph, of the British surveys of the Bay of Fundy and Gulf of St. Lawrence with the United States coast survey. Commander Shortland writes me that he will be in readiness to meet us at Halifax the beginning of November."

In this section, Wm. Mitchell, esq., has also been engaged in astronomical observations for the use of the coast survey. His results for

the year consist of 200 pairs of zenith distances of stars, 37 moon culminating observations, 2 occultations, and 50 meridian transits for time.

Secondary triangulation.—The scheme of secondary triangulation of the coast of New Hampshire and part of Maine, between the Piscataqua and Saco rivers, commenced last year by Captain T. J. Cram, United States topographical engineers, assistant in the coast survey, has been completed this season to the line Ossipee—Fletcher's neck, (see sketch A,) including its complete connexion with the primary work. The party took the field on the 20th of June, between which date and the 7th of October, to which Captain Cram's report extends, 20 stations were occupied, and 952 sets of observations made on 199 points, consisting of stations, light-houses, steeples, &c, with the twelve-inch repeating theodolite of Troughton & Simms, (C. S. No. 18.) Of these stations occupied, eight were in New Hampshire and twelve in Maine. Not less than six repetitions with the telescope direct, and six telescope reversed, were counted as a set; the total number of observations being 8,148. The area covered by the secondary triangulation proper, and including the triangles which connect it with the primary work, is 700 square miles.

At the station marked "Mason" on the sketch, the instrument was elevated fifty-two feet above the ground, to avoid expensive cutting of the woods around it. Captain Cram reports the results of this experiment to be satisfactory.

This work is connected with the secondary triangulation of the coast of Massachusetts, by assistant C. O. Boutelle, on the southwest, at the line "Powow—Seabrook;" with the secondary triangulation laid out for Casco bay, by the same assistant, on the line "Fletcher's neck—Ossipee:" it unites with the triangulation of Portsmouth harbor, by Captain Stansbury, United States topographical engineers, on the line "Newcastle—Pulpit rock," and is controlled by the connexion with the primary stations "Pattuccawa," "Agamenticus," and "Ossipee," and the stations "Isle of shoals" and "Fletcher's neck," observed upon in the primary series. In all the connexions referred to, the importance of which is ably set forth in Captain Cram's report, there are lines of verification.

Captain Cram was engaged during the winter in copying in duplicate and in computing his work of the past season, as far as the data were complete; the entire office work was not, however, finished, before it was necessary to take the field; so that with the completion of the scheme of triangulation of this part of the coast this year, there is a considerable accumulation of office-work.

After the date of my report of last year, assistant C. O. Boutelle completed his work connecting the secondary triangulation of the coast of Massachusetts with that of New Hampshire and Maine, erecting the necessary signals and measuring the angles, between the 1st of October and 8th of November. The number of stations occupied was 12, and 156 angles were measured, upon 154 objects, by 950 observations. Vertical angles were also measured upon 38 objects, 59 zenith distances being determined by 578 observations. The instrument used in both cases was an eight-inch theodolite by Gambey, (C. S. No. 24.) In

reference to the method of determining heights by observing zenith distances, Mr. Boutelle remarks:

“The height above the mean level of the sea of the point of observation, in the tower of the Harris street church, (Newburyport,) has been carefully determined. The plane of mean level of the sea was obtained by observations on seven consecutive tides in the Merrimack river, at one of the Newburyport wharves. These were referred to a bench-mark on the top of the wharf, from whence a series of levels was carried to the church. It is pleasant to be able to state that the height of ‘Powow hill,’ determined from these observations, differed less than a foot from that obtained by a series of zenith distances, running through many sides of triangles, from levels taken at Dorchester Heights and Nantasket, in Boston harbor.”

Mr. Boutelle was assisted by Messrs. Fairfield and Gregorie. After closing this work, he proceeded to the office to prepare for the duty assigned him in Section V, of which an account is given in its proper place.

Topography.—The topography has employed two double parties and one single party during the chief part of the season: one of the former working on Cape Cod, the other on Cape Ann, and the latter near Newburyport. The plane-table sheets are shown on sketch A, and are numbered 28, 31½, 37, 38, 39, and 41. The area embraced in them is 66 square miles, and the extent of shore-line 217 miles.

The weather, which has been generally unfavorable for the operations of the survey, has been very favorable to the execution of the topography. The nature of the ground in this section makes it, however, the most difficult to represent, from its varied surface, and from the number of details required in many places by the closely settled character of the country.

A double party (that is, a party working two plane tables) under the charge of assistant H. L. Whiting, with Mr. R. M. Bache as assistant, has been occupied from the latter part of June until early in October, in continuing the topographical survey of Cape Ann. The work is comprised in three sheets, Nos. 37, 38, and 39, (sketch A,) and extends from Beverly farms, near Salem, along the south shore of the cape to its extremity; and on the eastern shore to Halibut Point, the north-eastern point of the cape. The area embraced is 35 square miles, the extent of shore-line 60 miles, and the extent of coast measured, in its general direction, about 18 miles. The topography includes Manchester and Gloucester harbors, and Rockport, and extends from the shore to the nearest road in the interior, thus including nearly all the area between the water-line and the rocky and wooded portion of Cape Ann, until near the eastern portion, when it embraces the highest ground of the cape. The difficult character of this survey will be understood from Mr. Whiting’s general description of the topography of the cape: “The character of the country is broken and rocky. The range of hills forming the back-bone, as it were, of the cape, is covered with a mixed growth of pine, oak, maple, &c., and is generally unsuceptible of cultivation; the land is sterile, and among the valleys and broken ridges are numerous swamps. The average height of the hills

of San Francisco bay and of San Diego harbor has been made. Planetable surveys for sites of light-houses have been made in San Francisco bay and its approaches, at Monterey, Point Conception, San Diego, and Cape Hancock, or Disappointment, and its vicinity, including Cape Adams. Surveys for the joint commission for naval and military defences have been made at Mare island, near Vallejo, and on both sides of the entrance to San Francisco bay. A full hydrographic reconnaissance has been made of Columbia river from its entrance to a point above Astoria, of Humboldt harbor and river, and of Trinidad bay; and a general hydrographic reconnaissance is in progress from Monterey to San Diego, as supplementary to that of last year from Columbia river to Monterey. Buoys have been sent to Columbia river by direction of the Treasury Department, to be placed by the coast survey party there. A report on a light-house site at Humboldt harbor is received, and one at Umqua river has been directed. Tidal observations are making near San Francisco.

The chart of Columbia river has been engraved, and will be published after making provision for the introduction of reported recent changes, if found to be of importance. Sketches of the reconnaissance of Humboldt harbor, Trinidad bay, San Francisco entrance and bay, San Diego harbor, Cape Disappointment, Point Conception, Point Pinos, and Point Loma, have been engraved and published. The work in the field is in vigorous activity, and the arrangements in the office for publishing are most thorough and effective.

Besides the work stated in the several sections, the computation of the field work, the registry and assemblage of it, the reduction of the land work and hydrography in the office, have kept pace with the out-of-door operations. Fifteen maps have been electrotyped. Sixty-three sketches, including those showing the progress of the work, have been prepared and engraved, to accompany this report.

The list of geographical positions from the preliminary computations of the survey, with the necessary maps to render it available to geographers, surveyors, and others, has been prepared with much labor, and is now appended to this report. (Appendix No. 12.)

In the estimates for the next fiscal year, I provide for the continuation of the work on the same scale which has been heretofore approved by the Executive and Congress; expressing, however, my conviction, which has been before stated, that the appropriations for the Florida reefs and keys should be increased, for at least a few years, to sixty thousand dollars, so as to enable the work to be rapidly pushed in that quarter.

The publication of the observations made in the survey, to which I have also, from time to time, called attention, is very desirable. It will secure them from all possibility of loss; can be done better, more quickly, more accurately, with greater knowledge of all details, while the work is in progress, than after it has all closed. The publication of the observations would tend to facilitate the progress of the work itself, and furnish means of estimating the relative value of different processes used in it. It has been warmly recommended by one of the first scientific bodies in the country, the American Philosophical Society. The cost of publishing the data from the work, and many results which

we are now cramped for means to give to the public, would not exceed thirty thousand dollars for the first year, and might be less afterwards. They should be published in a form suited to scientific observations, and creditable to the country, and under close supervision at the Coast Survey office.

I am satisfied that it will be best for a few years to give the full appropriation asked last year for the western coast, that we may render the facilities which the great and rapidly increasing commerce demands. The navigation by steam renders the necessity for a knowledge of the coast more than ever important, as steam-vessels run a direct course, keeping near the land, and stopping from harbor to harbor, as commerce requires. Until we have the necessary information of a general kind, we ought to press the survey in that quarter. The results, even under the disadvantageous circumstances of the past year, show what may be done by zeal and industry, furnished with adequate means. The addition of another party there is very desirable.

In making these estimates, I suppose the usual aid derived under the law from the War and Navy Departments. The unusual calls during the past year for payment of transportation of naval officers on first joining the work, ordered often, as they are, from distant points, and for clerks or draughtsmen for the hydrographic parties when ashore, have pressed heavily on our limited means, which did not hold out to the end of the fiscal year. I have provided against the recurrence of this contingency by addition to the estimates for the coast of the Atlantic and Gulf of Mexico, which, though small, is necessary to prevent the cutting off of part of the anticipated operations.

ESTIMATE FOR THE FISCAL YEAR 1852-'53.

General expenses for all the sections, namely: rent, fuel, postage; materials for drawing, engraving and printing; carpenter's work and materials; instrument maker's work and materials; blank-books, stationery, printing and ruling forms; binding; transportation of instruments, maps and charts, and miscellaneous office expenses; purchase of new instruments, books, maps, and charts..... \$16,000

SECTION I. Coast of *Maine, New Hampshire, Massachusetts, and Rhode Island. Field-work.*—To extend the primary triangulation in *Maine*, and make the reconnaissance and astronomical and magnetic observations connected with it; to extend the secondary triangulation over *Casco bay*, (*Portland*), and to determine the heights of the stations between *Portsmouth (New Hampshire)* and *Portland*; to complete the topography of *Newburyport* harbor; to commence that of the coast between *Portsmouth* and *Portland*, and of *Portland* harbor; to complete the topography of *Cape Ann*; to continue the hydrography of the *Nantucket* shoals, and of the ocean near *Nantucket*; to commence that for off-shore chart No. 2; to complete that of *Chatham, Gloucester*, and *Annis Squam* harbors, and to commence those of *York, Saco*, and *Kennebunk*; to continue the observations of tides and currents in *Martha's Vineyard* and *Nantucket* sounds,

and to take the views required for the general coast chart No. 2. *Office-work*.—To make the reductions and computations for the section; to complete the drawing of coast chart No. 3, from *Cape Pogue* to *Chatham* light, the drawing of *Salem*, *Newburyport* and *Portsmouth* harbor charts, and to commence those of *Chatham*, *Gloucester*, *Annis Squam*, and *Portland* harbors; to continue the engraving of *Boston* harbor chart; to complete those of *Newburyport*, *Salem* and *Portsmouth*,—will require

\$36,000

SECTION II. Coast of *New Jersey*, *Pennsylvania* and *Delaware*.

To continue the triangulation and hydrography of the *Hudson*; to make such work of verification as may be required; to complete the observations of tides and currents for off-shore chart No. 1; to complete the engraving of south side of *Long Island*, middle sheet; to complete the engraving of *Connecticut* river entrance,—will require

7,000

SECTION III. Coast of *Delaware*, *Maryland*, and *Virginia*.

Field-work.—To complete the triangulation of the shores of the *Chesapeake*, and of adjacent bays and roadsteads in *Virginia*, of the outer shore to the capes of *Virginia*; to make the astronomical and magnetic observations required, the secondary triangulation of part of the *Potomac* or of *James* river; to continue the topography of the shores of the *Chesapeake* to *York* river on the western shore, and *Tazewell's* on the eastern shore of *Virginia*, and of the outer shore of the peninsula to *Rogue's* island; to continue the hydrography of the outside to *Rogue's* island, and of the *Chesapeake* to *York* river, nearly. *Office-work*.—To make the computations for the section; to complete the drawing of a third sheet of the *Chesapeake* bay, and to commence the second series; to complete a sheet of the general coast chart of the outer coast; to complete the engraving of the first sheet of *Chesapeake* bay, and of a general chart of the upper section of the bay,—will require

33,000

SECTION IV. Coast of *North Carolina*.—To make the reconnaissance required in this and the next section; to continue the primary triangulation over *Pamlico* sound; the secondary triangulation northward, nearly to its connexion with that of the *Chesapeake*; to complete the tertiary triangulation of *Core* sound, and connect it with *Beaufort* harbor; to continue the triangulation of the *Cape Fear* river; to complete the topography of the ocean shore from *Hatteras* to *Ocracoke*, and of *Currituck* sound and the ocean shore northward, to beyond the *Virginia* and *North Carolina* line; to complete the hydrography of *Currituck* sound to the limits of the triangulation; to continue that of *Pamlico* sound and *Ocracoke* inlet; to continue that of the entire coast between *Cape Hatteras* and *Cape Fear*; to continue that of the *Cape Fear* river to *Wilmington*, (N. C.); to make the observations in the *Gulf Stream* in this section. *Office-work*.—To complete the drawing of the chart of *Albemarle*,

Croatan, Roanoke, and part of *Currituck* sounds; to continue the engraving of the first sheet; to draw and engrave the chart of *Cape Fear* entrance, of the *Fryingpan* shoals, &c.,—will require

\$25,000

SECTION V. *Coast of South Carolina and Georgia. Field work.*—To continue the secondary triangulation from its present limit eastward to *Charleston*, and westward from *Beaufort*, South Carolina; to complete the triangulation of the *Savannah* entrance and river, and of *Calibogue* sound; to continue the primary triangulation eastward to *Charleston*; to complete the topography of *Kiawah*, *James's* and *John's* islands, and of the shores of *Stono* and *Ashley* rivers; to complete the hydrography of *St. Helena* and *Calibogue* sounds, and to commence that of the ocean coast between *Charleston* harbor and *Savannah* entrance; to make the *Gulf Stream* exploration in this section; to make tidal observations at *Charleston* and *Savannah* entrance. *Office work.*—To make the computations required for the section; to complete the drawing of *Savannah* river, the engraving of the chart of *Charleston* harbor, and of *Savannah* harbor, entrance, and river, and of *North Edisto* harbor of refuge,—will require

23,000

SECTION VI. *Reefs, keys and coast of Florida.*—See estimate for special appropriation, as provided for the three years last past.

SECTION VIII. *Coast of Alabama, Mississippi, and Louisiana.*—To continue the main and secondary triangulation southward from the *Chandeleur* islands towards the mouths of the *Mississippi*; to complete the connexion of *Washington*, *Mobile* and *New Orleans*, for difference of longitude by telegraph; and to make a triangulation of the principal entrances of the Delta of the *Mississippi*; to continue the topography of the shores of *Pontchartrain* and of the *Chandeleur* islands and main; to continue the hydrography of *Mississippi* sound, and of *Louisiana* bay; to make tidal observations at several points on the coast of *Louisiana*. *Office work.*—To make the computations and reductions required by the field work of the section; to complete the drawings of the two eastern sheets of the map from *Mobile* entrance to the mouths of the *Mississippi*; the engraving of one sheet of *Mobile* bay, and the commencement of a second

25,000

SECTION IX. *Coast of Texas.*—To continue the main and secondary triangulation, to include part of *Espiritu Santo* bay; to continue the topography westward, to include *Matagorda* bay; to continue the hydrography of the outer coast and of the entrances, and *Matagorda* bay, and the tidal observations at points of the coast. *Office work.*—To complete the drawing of the map of *Galveston* upper and lower bays, and to commence the first sheet of the general coast chart of *Texas*; to complete the engraving of the chart of *Galveston* entrance, and to commence that of *Galveston*

bay; to make the computations and reductions required for the work of the section,—will require..... \$21,000

SECTIONS X and XI. Western coast, *California* and *Oregon*.—

See estimate provided for, as last year, by special appropriation.

Total, exclusive of Florida reefs and keys, and of the western coast..... 186,000

SECTION VI. To continue the survey of the *Florida* coast, reef, and keys. *Field work*.—To complete the triangulation of the *Walker* keys; to continue that of the reef from *Key Rodriguez* southward and westward to *Key Vacas*; to continue the secondary triangulation of the western coast of *Florida* from *Crystal* river southward; to complete the topography of the keys to the limits of the triangulation; to continue the hydrography of the outer coast and reef, from *Ajax* reef southward. *Office work*.—To make the necessary computations and reductions; to complete the drawing of *Boca Grande* passage, and *Bahia Honda*, and the engraving of the chart of *Key West* harbor and the approaches; and sketches of the *Boca Grande* passage and *Bahia Honda*—will require \$30,000

SECTIONS X and XI. To continue the survey of the western coast, *Oregon* and *California*. *Field work*.—To determine the geographical positions, absolute and relative, of the most important capes and headlands in *California* and *Oregon*; to complete the triangulation of *San Francisco* and *San Pablo* bays, &c., and of *Santa Barbara* sound; to complete those of the several harbors already examined; to continue that of the *Columbia* river, and of *Puget's* sound; to complete the topography for the harbor charts already commenced, and for the sites of light-houses; to complete the hydrography of the *Columbia* river; to continue that of *San Francisco* bay, of *Monterey*, *Santa Barbara*, &c.; to complete the general examination of the harbors of the coast and to revise the general reconnaissance of the coast. *Office work*.—To make the computations and reductions; to complete the drawings and engravings for the sites of light-houses, and of the examinations of harbors; to continue those of *San Francisco* bay, *Monterey*, and the revised reconnaissance; to provide for the drawing and engraving of sketches received; for the engraving of the revised general coast reconnaissance; of the *Columbia* river survey; of *Santa Barbara* sound, &c.,—will require..... 150,000

The appropriation for the western coast will include the necessary repairs and expenses of a steam-vessel, and will add one party to those operating in that quarter.

The appropriation for the coast of the Atlantic and Gulf of Mexico in 1850–51, was..... 186,000

For the Florida reefs, keys, and coast..... 30,000

For the western coast, including the cost of a steam-vessel.. 190,000

For the next year—the present fiscal year—the appropriations were severally \$180,000, \$30,000, and \$100,000. I am satisfied, from experience, that the sums now asked are as small as, with the most economical administration of the survey, the work marked out can be executed for; requiring a close and constant care to make them give these results. The plan of operation is in a degree deranged, and the relative parts make a progress not adapted to each other, when the amounts are lessened; besides which, a portion of the work is necessarily cut off, and the survey makes slow progress. I am of opinion that true economy in such a work is to be found by enlarging the operations, thus increasing the division of labor. The work being of a temporary character, the enlargement of its expenditures is more than made up to the treasury by its less duration.

I proceed, next, to give a more particular account of the operations on the several sections of the coast, derived from the reports of the assistants and others employed; prefacing the more detailed statements with remarks on the progress of the section, and on the more interesting general results. The incidental notices of the office-work which thus occur in connexion with the sections, are followed by a complete detail of the progress in its various departments.

A table of occupation of the field and hydrographic parties is given in the Appendix, (No. 1,) showing their distribution during the different seasons appropriate to surveying different parts of the coast.

The light-house work executed in the different sections is stated in the general table, (Appendix, No. 15,) and more in detail under the head of each geographical section of the coast.

In the Appendix to this report, Nos. 13 to 14 *bis*, inclusive, will be found the instructions of the Treasury Department, and the general correspondence on the subject of light-houses, &c.; special reports being elsewhere given in the Appendix, in connexion with the section to which they refer. The Appendix No. 16 contains a circular to the chiefs of hydrographic parties, referring to a communication from the secretary of the Light-house Board, asking suggestions for the improvement and extension of the present light-house establishment, and extracts from the replies.

SECTION I.—FROM PASSAMAQUODDY BAY TO POINT JUDITH, INCLUDING THE COAST OF MAINE, NEW HAMPSHIRE, MASSACHUSETTS, AND RHODE ISLAND.—(Sketch A.)

The new appropriation having been available from the very beginning of the fiscal year, the work in this section has made very good progress. Two triangulation, three topographical, and two hydrographic parties, were at work during nearly the whole of the season; one of the triangulation parties making also the astronomical and magnetic observations connected with the primary work; two of the topographical parties using each two plane tables; and one of the hydrographic parties having, for the greater part of the time, three vessels—one of them a steam-vessel. The primary triangulation was extended to Cape Small Point, at the mouth of the Kennebec, and the reconnaissance for it beyond the Penobscot. The secondary triangulation

completed to Portland. The topography of Cape Cod, Cape Ann, and Newburyport harbor, in Massachusetts, was nearly completed. The hydrography of Nantucket shoals was continued; that of Salem, Chatham, Portsmouth, and Newburyport harbors completed; off-shore work off Block island and Gay Head was executed; and tides and currents were observed near the Elizabeth islands, in the Vineyard sound and Buzzard's bay, at Holmes' Hole, Salem, Newburyport, and Portsmouth. The permanent tidal station at Charlestown, Massachusetts, has been kept up, and observations for several lunations have been made in Salem, Portsmouth, and Newburyport harbors. The office-work has made corresponding progress.

Accompanying this report (sketch A, No. 3) is a current chart, showing the nature and results of observations of previous years in the harbor of Boston.

The preliminary chart of Richmond's Island harbor, issued to meet the wants of the Committee on Commerce, has given place to a more complete map.

During the great gale of April last, the violence of which was especially felt on the coast of Massachusetts, an opening was made through Chatham beach, (see sketch A,) giving a more direct and deeper entrance to the harbor of Chatham than had previously, at least of late years, existed. This attracted much attention, and hopes were entertained that a harbor of refuge might thus be obtained at a point where one was much needed. I incorporated in the instructions of the season directions to examine Chatham harbor, and if the bar and entrance were found in a moderately permanent condition, to make a complete survey of it. The topographical party of Assistant J. B. Glück was instructed to complete, without delay, the shore line; and Lieutenant Commanding Woodhull to take some convenient opportunity, towards the close of his operations in the Vineyard sound, to make the desired examination. This was promptly executed. The greatest depth which he found could be carried over the bars, at *high* water, was eleven feet; the rise and fall of the tide being about four and a half feet. There is deep water—in one spot twenty-two feet at low water—near the village of Chatham. The changes from week to week in the *outer bar*, he was satisfied, were such that a chart could not be made which would be of service to navigation. He accordingly recommended the postponement of the survey until a more permanent condition was reached; making, meanwhile, quite a careful examination, which has been plotted, and the chart representing which has been placed on file in the office, where it may be consulted by, or copied for, those who are especially interested in the matter.

The occupation of some twelve more stations will complete the primary triangulation to the northeastern boundary. The reasons which render it more expedient to employ a party only during part of the season for this purpose, have been frequently stated. The primary triangulation is still in advance of the secondary, though, in consequence of the desirableness of prompt surveys of some of the harbors in the more eastern part of the section, that operation has been pushed well forward.

The difficult and comparatively expensive hydrography of the Nan-

tucket shoals, has delayed the hydrography beyond my calculations. The transfer of one of the southern hydrographic parties to this section formed part of my plan for the past season, which was interrupted by causes beyond my control, and which it is not necessary here to state. The plan is only deferred, not given up. The examination for a base of verification will be made next season, or in the following one; and, should a suitable one be found, the triangulation will be directed in reference to a junction with it.

The tides, and currents resulting from them, in the passages between the Elizabeth islands are altogether peculiar, and require close investigation. On one side of the islands the rise and fall belongs to Buzzard's bay; and on the other side to the Vineyard sound. The Buzzard's bay tide is propagated through the entrance between Cuttyhunk and Saghkonnnet Point. (See sketch A.) The two chief passages used by vessels between the Vineyard sound and Buzzard's bay are Wood's Hole and Quicks' Hole. The plan which I sketched for determining the facts in regard to the tides was the establishment of three tide-gauges, to be observed during the same period on the north side of the Elizabeth islands at Wood's Hole, Kettle cove, and Quicks' Hole; and on the south side at Wood's Hole, Tarpaulin cove, and Quicks' Hole. These observations would give the corresponding phenomena and their progress between the two passages, and, being completed satisfactorily, the gauges from Kettle and Tarpaulin coves were to be removed to points nearly midway, or, better, at or near the point of meeting of the tides from the bay and sound, between the two gauges in Wood's and the two in Quicks' Hole, so as to determine the relation of the movement in these passages. This plan has been satisfactorily carried out during the present season, except that three days of simultaneous hourly observations, which I considered essential to its completeness, could not be made on account of the boisterous character of the weather.

During the season I had repeated conferences with the chiefs of parties in this section when the diversified operations required it, but made no special inspection. The inspection of a portion of the operations was made by Major I. I. Stevens, of the corps of engineers, assistant in charge of the office.

In 1849, a special expedition for the determination of the difference of longitude between the coast survey stations and European observatories was organized and reported upon. During the following year the reduction of the observations was made, so as to draw upon the experience of that operation for improvement in a subsequent one. During the past season the second trial has been made, the general results of which will be stated in their place from the report of Professor W. C. Bond, director of the Cambridge observatory, by whom, in concert with Mr. Hartnup, director of the Liverpool observatory, the work has been executed.

Arrangements have also been made, through Professor Bond, for connecting the coast survey of the United States with the surveys making by the British government in Nova Scotia. The occasion will be taken to obtain the longitude, by telegraph, of Bangor, in Maine, an important point in every respect, while facilitating the connexion of Cambridge and Halifax. The thanks of the Survey are due to H. O. Alden, esq.,

the president of the Maine Telegraph Company, for assistance rendered in these operations. (See Appendix, No. 18.)

The appropriations for light-houses, beacons, buoys, &c., embraced in the bill approved March 3, 1851, for localities within this section, were the following:

"*Maine*.—1. For buoys on White's and Thom's ledges, and on Pond Island reef, at the mouth of the Kennebec river, three hundred dollars.

"2. For a light-house on Pond island, at the entrance of Narragagus bay, four thousand dollars.

"*Massachusetts*.—3. For a light-boat on the Shovelful shoals, off Chatham, twelve thousand five hundred dollars.

"4. For eleven buoys in the channel to Commercial point and Neponset river, in Dorchester, one thousand dollars.

"5. For a light-house at the head of Holmes' Hole harbor, three thousand five hundred dollars.

"6. For a beacon on Fawn bar, near Deer island, Boston harbor, two thousand five hundred dollars.

"7. For two iron spindles on the northeast ledge of the Graves, and on Harding's ledge, Boston harbor, two thousand dollars.

"*Rhode Island*.—8. For a light-boat off Brenton's reef, fifteen thousand dollars."

Examinations of all these were required, under the law, by the Fifth Auditor, and were made, according to the instructions from the Treasury Department, under my direction. My reports will be found in the Appendix, (Nos. 19, 20, 21, and 22,) accompanied by those of the assistants of the survey to whom the examinations were referred, (Lieutenants Commanding Charles H. McBlair and Maxwell Woodhull, United States navy,) which contain all the details necessary to an understanding of the subject. In every case a thorough examination of the localities was made, wherever the coast survey extended, by the aid of its charts, and the reports state fully the requirements of navigation in reference to the objects embraced in the bill.

The buoys at the mouth of the Kennebec (No. 1) were recommended to be immediately placed, (July 28.) The light-house on Pond island, Narragagus bay, (No. 2,) was also recommended to be erected, to contain a revolving light. A light-boat on the southeast extremity of Shovelful shoals, off Chatham, (No. 3;) a beacon on Fawn bar, near Deer island, (No. 6;) and two iron spindles on the Graves and Harding's ledges, Boston harbor, (No. 7,) and the light-boat off Brenton's reef, (No. 8)—were recommended to be placed. The buoys in the Neponset river (No. 4) had already been reported upon favorably from the office of the Coast Survey. Instead of the light-house at the head of Holmes' Hole, three small beacon-lights, (technically called "bug-lights,") for ranges, were recommended, and their positions indicated on a chart. It was supposed that the three beacon-lights could be put up for the amount of the appropriation for a single light-house.

A fog-whistle for the light-house on Petit Menan island, instead of the present fog-bell, and a buoy on Thomas' reef, near Thom's reef, at the entrance of the Kennebec—objects for which an appropriation had been made—were reported as desirable.

The reports of the examining officers not only show that there are

good reasons for establishing the facilities to navigation provided in the act of Congress for this section of the coast, but give collateral information and facts of very considerable interest, adding much to our knowledge of the coast.

In a communication, in reply to questions from the Light-house Board, Lieutenant Commanding McBlair presents the following subjects for consideration: 1. The substitution of a light-house on the ledge called Sow-and-Pigs, off Cuttyhunk, at the entrance to Buzzard's bay, for the light-boat now placed there, and the light-house now existing on the island of Cuttyhunk; (see sketch A.) 2. The placing of a floating beacon on Davis' New South shoal; (see sketch A, No. 2.) This shoal lies near one of the most frequented parts of the ocean, and has occasioned some very disastrous wrecks. It has as little as eight feet water upon it, is swept by very strong tidal currents, and, during the summer months, is almost constantly hidden by fogs. It was designed at one time to erect a beacon upon it; but the great difficulties of the undertaking, arising from the character of the climate and the distance of the nearest port, seem to be regarded as insuperable. It is, however, indispensable to the safety of passing vessels that it should be marked in as distinct a manner as circumstances will admit. 3. A buoy-boat on the Great Rip, one of the most extensive of the Nantucket shoals. 4. A buoy-boat on the sand shoal lying to the eastward of the northern end of Bass Rip. 5. A spar-buoy on the sand-spit extending from Fox's Point, Nashawena island, at the southern entrance of Quicks' Hole; (see sketch A.) 6. A wooden beacon, (to be painted black,) on Long island, Boston harbor, placed so as to range with the northeast end of Spectacle island, for the safe navigation of the main ship channel; (see sketch A;) recommended also by Lieutenant Commanding Charles H. Davis, in 1847. 7. A similar beacon on the southeast part of Long island, Boston harbor, to range with Nix's Mate, and to facilitate the passage through the Broad Sound channel. 8. A buoy-boat on the southwest end of Billingsgate shoal, Manchester bay, and two spar-buoys on the southern edge of the shoal, planted at regular intervals between the boat and Billingsgate island. 9. A spar-buoy on Bibb Rock, southward and westward of Wellfleet harbor. 10. Changes in the position of the lights at Chatham, to adapt them to the changes in the coast there.

These recommendations are fully concurred in, as his field of work has extended, by Lieutenant Commanding Swartwout, who commanded the brig Washington, attached to Lieutenant Commanding McBlair's party.

In connexion with this subject I present the following extract from a report (November, 1850) of Lieutenant Commanding Maffitt, United States navy, assistant in the coast survey:

"I examined a rock in the main ship channel, Boston harbor, near the buoy of the Lower Middle, upon which the British mail steamship Cambria struck, and found it to be identical with a rock already found on the Coast Survey chart to be seen in the work of 1847."

Reconnaissance.—It has been necessary merely to extend the reconnaissance in this section, during the present season, to one range of stations beyond the Penobscot, in order to prevent possible interference with the primary triangulation of the next season. This has been done

by assistant C. O. Boutelle, and the result is shown on sketch A. The fact that, if necessary to the work, either from the position of the final base of verification in this section or other cause, a point can be found on the Ebeeme mountains readily connected with the coast, has been ascertained. Mr. Boutelle also established the station on Ragged mountain, (Camden mountains.) He was accompanied during his reconnaissance by Major Prince, United States army, assistant in the coast survey.

Mr. Boutelle made, also, a reconnaissance for the main chain of secondary triangles over Casco bay in the course of the season.

Primary triangulation, astronomical observations, &c.—The party under my immediate charge was transferred to this section in July, and between the second of that month and the fifth of November two stations were occupied for geodetic and astronomical work, and one for astronomical observations. The magnetic variation, dip, and intensity, were measured at two of the stations; vertical angles were measured for height at the three; and a meteorological register was kept during the progress of the other observations. The area of the work, estimated in the usual way, was 2,402 square miles. I was assisted in the measurement of horizontal and vertical angles, and the azimuth determinations, by Lieutenant W. P. Trowbridge, of the corps of engineers, and the observations for time and latitude were made under my immediate direction by sub-assistant George W. Dean.

At Mount Pleasant station, (Oxford county, Maine,) 22 horizontal angles of the primary triangulation were measured by 1,300 observations, with the thirty-inch theodolite of Troughton and Simms, (C. S. No. 1,) 130 vertical angles for difference of height, with the micrometer of this instrument, and thirty for absolute elevation, by a six-inch Gambey theodolite, (C. S. No. 34,) sets of six repetitions being employed. A signal was placed upon the highest point of Mount Washington, and observed upon whenever the atmosphere was clear.

The azimuths were measured by seventy-two observations, in seven sets, on Polaris, near the upper and lower culmination, the method, referred to in my report of last year, of corresponding azimuths before and after culmination being used. The star was referred to a mark distant about three-quarters of a mile, nearly in a line to the Blue Mountain station, between which and the mark the angle was measured by the micrometer. The observations were made with the thirty-inch theodolite, (C. S. No. 1,) and in five positions of the instrument.

The latitude was determined by Talcott's method, with a zenith telescope by Würdeman, (C. S. No. 5,) which has been already referred to, having a focal length of forty-nine inches, an aperture of three and a half inches, and used with a magnifying power of six hundred. Two hundred and thirty-six observations were made upon forty-four pairs of stars, arranged from eighty-one stars taken from the Greenwich catalogue; using, also, as many as practicable of the stars of which the places have been determined by the Coast Survey zenith sector. The usual determination of the value of the micrometer and level divisions of the instrument were made. The longest and shortest sides of the primary triangulation of the season were eighty-four and twenty-two miles, respectively.

Some of the lines from Mount Pleasant having been obstructed by the erection of a new house upon the mountain, a second station point was selected by Mr. Boutelle, about fifty-seven feet from the first, and in the line from Sebattis to the original station. This distance was very carefully measured twice by a standard metre-bar placed on a wooden frame, the two measurements scarcely differing. They were made by myself, assisted by Lieutenant Trowbridge and Mr. Dean.

I was indebted for assistance, in posting heliotropers and other arrangements, to assistant C. O. Boutelle and Mr. Fairfield. Mr. Boutelle also observed for me during a brief absence, on duty, from Mount Pleasant.

At Ossipee station, (York county, Maine,) 15 horizontal angles were measured by 1,470 observations, with theodolite No. 1, and 128 vertical angles for height, with its micrometer, and with the six-inch Gambey theodolite, before referred to.

At Cape Small station, (Lincoln county, Maine,) eleven observations for azimuth were made on seven different days. The observations were made on Polaris—six at upper culmination, four at eastern elongation, and one at western elongation.

The observations for time and latitude, made under my direction by sub-assistant Geo. W. Dean, were as follows:

At Mount Pleasant station, 94 observations for time, upon 16 stars, paired as high and low stars, with transit C. S. No. 6, (Troughton and Simms,)—the equatorial intervals of the wires of this instrument were determined by 47 observations upon six stars. For latitude, 236 observations were made with zenith telescope C. S. No. 5, (Würdeman,) upon 44 sets of stars arranged from 81 different stars selected from the Greenwich twelve-year catalogue. When the places of the stars have been determined with the zenith sector as well as at Greenwich, equal weight has been given to each determination. For the value of the micrometer, 50 observations were made upon Polaris at eastern elongation, and 79 observations upon a collimator for value of level scale.

At Cape Small station, with the same instruments, 104 observations for time were made upon 14 stars, and 243 observations for latitude upon 40 sets arranged from 79 different stars. For the value of the micrometer of the zenith telescope, 91 observations were made upon Polaris at eastern elongation; for value of level of same instrument, 48 observations upon a collimator, in the usual manner.

The time of beginning and end of the solar eclipse of July 27, 1851, were observed at Mount Pleasant station.

The magnetic observations made by sub-assistant Dean, assisted by Mr. Edward Goodfellow, at Mount Pleasant and Cape Small, were as follows: For declination, 132 observations on 9 different days; for horizontal intensity, 7 sets on 7 days; and for dip, 5 sets on 5 days. The declination and intensity were observed with the portable declinometer of Gauss & Weber, as arranged by Professor Lloyd and Colonel Sabine, (Jones, No. 22, C. S. No. 1,) and the dip with a circle of eight inches, belonging to the Smithsonian Institution.

The meteorological observations at these stations, made by Mr. Edward Goodfellow and Mr. B. F. West, consisted of 328 readings for

temperature of the air, for moisture, (wet bulb thermometer,) for pressure, (Alexander barometer,) and miscellaneous.

Additional observations were made eight times a day, on eight days, of the barometer, thermometer, &c., by request of Professor Arnold Guyot, of Cambridge, to correspond with his observations for height in the White mountains and the adjacent country. The height of the surface plane, as shown by clouds resting on the Presidents' range, was also noted from Mount Pleasant at his suggestion. These observations were made by Mr. Edward Goodfellow and Mr. B. F. West.

The following magnetic observations were made by assistant J. E. Hilgard, between the 15th and 31st of August. The localities indicate the charts to which the results of the variation will be applied.

Stations.	Declination.	Dip.	Intensity.
Bramhall's Hill, in Portland.....	3 days	4 sets	2 sets.
Kennebunk Port.....	3 "	3 "	2 "
Cape Neddock.....	3 "	3 "	2 "

These observations complete the series as far east as Portland harbor.

The instruments used were the declinometer No. 20, by Jones, and a nine-inch dip-circle by Barrow, with reading microscopes and verniers.

Assistant S. C. Walker has collected, for convenient reference and comparison, all the results obtained by the transportation of chronometers for the differences of longitude of Harvard and Liverpool observatories. The data are those reported by William Cranch Bond, esq., director of the Harvard observatory, for the Coast Survey, and those of the special chronometer expedition of 1849-50, undertaken by the Coast Survey, and under Mr. Bond's immediate direction. They are classified as follows:

1. Results by chronometers making one *western* voyage, between Boston and Liverpool, and on trial for the government, or for the commercial marine.

2. Results by chronometers used in several western voyages prior to 1849.

3. Results of the western voyages in the special chronometer expedition of 1849-50 (also reported by Professor Bond) with ordinary chronometers.

4. As class 3, but with selected chronometers.

5. Results of eastern voyages, otherwise as class 3.

6. As class 5, but with selected chronometers.

The indiscriminate mean of the results by these six classes gives for the longitude of Cambridge, west of Liverpool, 4 hours 44 minutes 39.96 seconds.

The services of W. C. Bond, esq., director of the Cambridge observatory, have been rendered to the Coast Survey in various astronomical observations, telegraphic and chronometer operations, the nature and progress of which may be gathered from the following extracts from his report:

"I have to report the observation of thirty moon culminations, a portion of which have been forwarded to the Coast Survey office at Washington, corresponding to similar observations made at Point Pinos and San Diego, California, by Coast Survey assistant Davidson.

"Twelve occultations of stars by the moon and one solar eclipse have been observed at this place, the latter by four observers, each being furnished with separate chronometers and instruments. The telescopes used were of different kinds and powers, according to the suggestion of Mr. Airy, in his paper of instructions relative to this eclipse.

"The results which have been obtained by means of the electromagnetic apparatus for recording astronomical observations are quite satisfactory. This method of adapting the electric current to the wants of the astronomer, and which has grown up under the fostering care of the Coast Survey, is purely *American*, and is acknowledged as such in Europe.

"The complete apparatus designed and made by ourselves for the coast survey, after having been tested at this observatory during several months, was, with your consent, taken to England, and put in operation, in May last, at the Royal Astronomical Society's rooms in Somerset House, in London, where it was examined and tried by those who felt an interest in such matters, this being considered the most effectual course to pursue in order to convince astronomers of the superior accuracy, expedition, and convenience of this method. At the request of several distinguished scientific gentlemen, the coast survey apparatus was transferred to the rooms of the British Scientific Association, at Ipswich; and, subsequently, we were urged to have it put up in the department assigned to American inventions at the great Exhibition in Hyde Park. As a proof of the estimation in which this is held, I may be allowed to mention that the Astronomer Royal is now engaged in introducing the 'American' method of recording into the observatory at Greenwich; and we hear, through the newspapers, that the council-medal of the great Exhibition has been awarded to our apparatus: it had previously obtained the gold medal of the Massachusetts Mechanical Association. We have nearly completed a similar apparatus for our own use at this observatory, in order more particularly to observe moon culminations, in connexion with your apparatus, when it shall have been put in operation at the Seaton station, in Washington.

"The chronometer expedition, which you put under my care, for determining the differences of longitude of the observatories of Greenwich, Liverpool, and Cambridge, closed for the season—so far as the transfer of chronometers was concerned—on the arrival of the steamer *America*, on the 17th instant. We have, this year, the data given for differences of longitude by one hundred and ninety chronometers; these instruments are now on trial for their subsequent rates, and will be subjected, for temperature corrections, to the cold of the approaching winter.

"According to your instructions, I have made preliminary arrangements for the connexion in longitude, by means of the electric telegraph, of the British surveys of the Bay of Fundy and Gulf of St. Lawrence with the United States coast survey. Commander Shortland writes me that he will be in readiness to meet us at Halifax the beginning of November."

In this section, Wm. Mitchell, esq., has also been engaged in astronomical observations for the use of the coast survey. His results for

the year consist of 200 pairs of zenith distances of stars, 37 moon culminating observations, 2 occultations, and 50 meridian transits for time.

Secondary triangulation.—The scheme of secondary triangulation of the coast of New Hampshire and part of Maine, between the Piscataqua and Saco rivers, commenced last year by Captain T. J. Cram, United States topographical engineers, assistant in the coast survey, has been completed this season to the line Ossipee—Fletcher's neck, (see sketch A,) including its complete connexion with the primary work. The party took the field on the 20th of June, between which date and the 7th of October, to which Captain Cram's report extends, 20 stations were occupied, and 952 sets of observations made on 199 points, consisting of stations, light-houses, steeples, &c, with the twelve-inch repeating theodolite of Troughton & Simms, (C. S. No. 18.) Of these stations occupied, eight were in New Hampshire and twelve in Maine. Not less than six repetitions with the telescope direct, and six telescope reversed, were counted as a set; the total number of observations being 8,148. The area covered by the secondary triangulation proper, and including the triangles which connect it with the primary work, is 700 square miles.

At the station marked "Mason" on the sketch, the instrument was elevated fifty-two feet above the ground, to avoid expensive cutting of the woods around it. Captain Cram reports the results of this experiment to be satisfactory.

This work is connected with the secondary triangulation of the coast of Massachusetts, by assistant C. O. Boutelle, on the southwest, at the line "Powow—Seabrook;" with the secondary triangulation laid out for Casco bay, by the same assistant, on the line "Fletcher's neck—Ossipee:" it unites with the triangulation of Portsmouth harbor, by Captain Stansbury, United States topographical engineers, on the line "Newcastle—Pulpit rock," and is controlled by the connexion with the primary stations "Pattuccawa," "Agamenticus," and "Ossipee," and the stations "Isle of shoals" and "Fletcher's neck," observed upon in the primary series. In all the connexions referred to, the importance of which is ably set forth in Captain Cram's report, there are lines of verification.

Captain Cram was engaged during the winter in copying in duplicate and in computing his work of the past season, as far as the data were complete; the entire office work was not, however, finished, before it was necessary to take the field; so that with the completion of the scheme of triangulation of this part of the coast this year, there is a considerable accumulation of office-work.

After the date of my report of last year, assistant C. O. Boutelle completed his work connecting the secondary triangulation of the coast of Massachusetts with that of New Hampshire and Maine, erecting the necessary signals and measuring the angles, between the 1st of October and 8th of November. The number of stations occupied was 12, and 156 angles were measured, upon 154 objects, by 950 observations. Vertical angles were also measured upon 38 objects, 59 zenith distances being determined by 578 observations. The instrument used in both cases was an eight-inch theodolite by Gambey, (C. S. No. 24.) In

reference to the method of determining heights by observing zenith distances, Mr. Boutelle remarks:

"The height above the mean level of the sea of the point of observation, in the tower of the Harris street church, (Newburyport,) has been carefully determined. The plane of mean level of the sea was obtained by observations on seven consecutive tides in the Merrimack river, at one of the Newburyport wharves. These were referred to a bench-mark on the top of the wharf, from whence a series of levels was carried to the church. It is pleasant to be able to state that the height of 'Powow hill,' determined from these observations, differed less than a foot from that obtained by a series of zenith distances, running through many sides of triangles, from levels taken at Dorchester Heights and Nantasket, in Boston harbor."

Mr. Boutelle was assisted by Messrs. Fairfield and Gregorie. After closing this work, he proceeded to the office to prepare for the duty assigned him in Section V, of which an account is given in its proper place.

Topography.—The topography has employed two double parties and one single party during the chief part of the season: one of the former working on Cape Cod, the other on Cape Ann, and the latter near Newburyport. The plane-table sheets are shown on sketch A, and are numbered 28, 31½, 37, 38, 39, and 41. The area embraced in them is 66 square miles, and the extent of shore-line 217 miles.

The weather, which has been generally unfavorable for the operations of the survey, has been very favorable to the execution of the topography. The nature of the ground in this section makes it, however, the most difficult to represent, from its varied surface, and from the number of details required in many places by the closely settled character of the country.

A double party (that is, a party working two plane tables) under the charge of assistant H. L. Whiting, with Mr. R. M. Bache as assistant, has been occupied from the latter part of June until early in October, in continuing the topographical survey of Cape Ann. The work is comprised in three sheets, Nos. 37, 38, and 39, (sketch A,) and extends from Beverly farms, near Salem, along the south shore of the cape to its extremity; and on the eastern shore to Halibut Point, the north-eastern point of the cape. The area embraced is 35 square miles, the extent of shore-line 60 miles, and the extent of coast measured, in its general direction, about 18 miles. The topography includes Manchester and Gloucester harbors, and Rockport, and extends from the shore to the nearest road in the interior, thus including nearly all the area between the water-line and the rocky and wooded portion of Cape Ann, until near the eastern portion, when it embraces the highest ground of the cape. The difficult character of this survey will be understood from Mr. Whiting's general description of the topography of the cape: "The character of the country is broken and rocky. The range of hills forming the back-bone, as it were, of the cape, is covered with a mixed growth of pine, oak, maple, &c., and is generally unsuceptible of cultivation; the land is sterile, and among the valleys and broken ridges are numerous swamps. The average height of the hills

and ridges is from 150 to 200 feet, with occasional peaks of 225 and 230 feet.

"The extremity of Cape Ann, including the townships of Gloucester and Rockport, is nearly an island, formed by the inlet of Gloucester harbor and river from the south, and Annis Squam harbor and river from the north. These waters nearly unite; and formerly a canal was opened, making a communication between them; but the tide meeting from the two entrances and the shoal waters of Squam river made it of little service; and now the main road to the peninsula is diked across the canal, entirely closing it.

"The interior of the peninsula is lightly wooded among the hills and swamps, but generally barren of foliage. The land first seen from sea is 'Poole's hill,' about 230 feet high. Pigeon hill is about 195 feet; but being quite near the shore, is soon made from sea. Rail-cut hill is about 210 feet, and near Gloucester harbor.

"The character of the shore and waters of Cape Ann is more bold and broken than any thus far surveyed in this section."

The shores of the extremity of Cape Ann are bold and abrupt. "Coasting vessels, in rounding the cape, pass quite near the shore; and the harbor of Gloucester is quite deep in comparison with similar waters to the westward.

"There are some dangerous ledges and rocks off the eastern point of the cape, the 'Salvages,' the 'Londoner,' &c.; but the lights of Thatcher's island are sufficient guides to navigators in avoiding them, and I believe but few wrecks or disasters occur to vessels in passing the cape.

"The character of the topography has been of the most complicated and intricate kind, the details in contour, outline of shore, &c., being the greatest yet surveyed in this section. The artificial details in the towns of Manchester, Gloucester, and Rockport, are also very great."

The work in Beaufort harbor, North Carolina, by Mr. Whiting, is described under the head of Section IV; he is now under instructions to proceed to Savannah river, (Section V.)

A double party, under charge of assistant J. B. Glück, with Mr. W. S. Walker as aid, was at work on Cape Cod from the latter part of July to the close of October; at first on the sheet No. 28, in the vicinity of Chatham, and next on No. 31½, near Welfleet. Up to the first of October, the area surveyed was eleven and five-eighths square miles, and the extent of shore-line 72 miles. In his report, Mr. Glück remarks: "In illustration of the intricate nature of topography upon sheet No. 28, Cape Cod, I would state here, that an area of only 7¼ square miles contains not less than 162 hill-tops, 143 hollows, and 21 ponds of larger and smaller size, with hills from 10 to 100 feet high, the representation of which forms a most complicated system of horizontal curves; a circumstance which should explain satisfactorily the comparatively small amount of area surveyed upon Cape Cod." The shore-line of Chatham harbor was furnished to the hydrographic party who made the examination there.

On the Welfleet sheet, (No. 31½,) Mr. Glück surveyed 5½ square miles, and determined 18 miles of shore-line, closing his work in this

section, and transferring his party to the Patapsco (Section III) at the close of October.

The surveying done by Mr. Glück in Sections II (for light-houses in New York harbor) and III (Patapsco river,) will be found noticed in its appropriate place.

Assistant A. W. Longfellow commenced the execution of the topography of Newburyport harbor on the 15th of August, and will discharge his party about the 20th of November. Up to the 1st of November he has surveyed an area of $13\frac{1}{2}$ square miles, and an extent of shore-line of 67 miles. The work was begun on Plumb island, and included, first, the immediate shore-line of the harbor and approaches, which were furnished at once to the sounding party, for use in their operations. It includes the wharves and principal streets of the city, and will comprise, this season, all that is necessary for a harbor map. The plane-table sheet of this work is numbered 41 on the sketch A.

Hydrography.—The party under the command of Lieutenant Charles H. McBlair, United States navy, assistant in the coast survey, commenced work about the close of June, and finished about the middle of October. (See sketch A, Nos. 1 and 2.) The continuation of the hydrography of Nantucket shoals formed the first object of the season; next, the completion of the work in Muskeget channel, for the chart of that passage, which is nearly prepared for publication; next, some supplementary work between Martha's Vineyard and Block island, for the off-shore chart, which is also nearly engraved; and last, the completion of the hydrography of Salem harbor. The progress made, to September 25, is stated by Lieutenant Commanding McBlair in his annual report, as follows:

“The hydrography of the shoals was prosecuted between the 3d July and 8th September; that of the Muskeget channel, between the 9th and 13th of September; and the remaining period, between the last date and the present time, has been occupied in the filling-in work to the westward of Martha's Vineyard.

“The results obtained in the different sections are exhibited in the annexed tables. (See sketch A, Nos. 1 and 2.)

1. *Field of work.*—*Nantucket Shoals.*

Area included within sounding limits	130 square miles.
Extent of sounding lines	252 miles.
Number of casts of lead	2,622
Depth of water	varying from 13 feet to 23 fathoms.

2. *Field of work.*—*Muskeget channel and approaches.*

Area within sounding limits	43 square miles.
Extent of sounding lines	103 miles.
Number of casts of lead	2,956
Depth of water	varying from 6 feet to 21 fathoms.

3. *Field of work.*—*Between Block Island and Gay Head.*

Area within sounding limits.....	105 square miles.
Extent of sounding lines.....	146 miles.
Number of casts of lead.....	1,000
General depth of water.....	18 fathoms.

"The hydrography of the Nantucket shoals (sketch A, No. 2) embraced the completion of the survey of the shoal to the north and west of Davis's bank, the re-examination and continuance of the survey of Davis's bank, and the determination of a part of Fishing Rip.

"The shoal north of Davis's bank is only separated from the Great Rip by a narrow slue, and may be regarded as merely the southern extremity of that shoal.

"Davis's bank is found to extend upwards of seven miles to the southward of its supposed limits in that direction, but our opportunities did not enable us to reach and determine its extreme southern point. The Fishing Rip is only generally established as to position.

"To determine its outline, extent, shoalest water, and general characteristics, will require a more extended and minute examination than it was in our power to bestow on it during the season.

"The past summer has been marked by an extraordinary prevalence of fogs and gales, which have seriously interrupted our operations, and limited the results."

On closing this part of the work Lieutenant Commanding McBlair, in the steamer Bibb, proceeded to Wellfleet to examine changes which were alleged to have been made, in the great storm of April last, in that harbor. The verification of the hydrography did not show such changes. The party next completed the hydrography of Salem harbor; and the means disposable for this portion of the work being exhausted, the steamer was laid up at Boston, and the officers, detailed for office duty, reported for the discharge of it at the Coast Survey office in Washington. The supplementary report of Lieutenant Commanding McBlair states the work in Salem harbor as follows:

"The survey embraces the harbor and approaches of Salem, Beverly, Manchester, and Marblehead.

"It has been executed almost altogether in boats, and necessarily with more than usual minuteness, in consequence of the numerous ledges and shoals which obstruct the passages.

"We commenced operations on the 3d instant, and finished on the 15th. The following table exhibits the amount of work performed, and the results obtained:

Area within limits of sounding lines.....	21 square miles.
Number of miles of soundings.....	176
Number of casts of lead.....	7,424
Depth of water sounded in.....	from 3 feet to 23 fathoms.

"Observations were made in the main ship-channel, to determine the direction and force of the current."

Lieutenant Commanding Swartwout, in the brig Washington, was detached, for a part of the season, in this section, upon the survey of No-Man's-Land channel, between the island of that name and Martha's

Vineyard island, and also upon off-shore soundings, between the meridians of Gay Head and Beaver Tail.

The survey comprised an area of 14 square miles, in which 1,200 soundings were made, and 81 angles observed, the depth of water varying from 8 feet to 11 fathoms. The off-shore work consisted of 160 soundings, over 3 lines, the total length of which was 176 miles.

In execution of his instructions, Lieutenant Commanding Woodhull, United States navy, assistant in the coast survey, in the schooner *Madison*, has occupied 8 stations in the Vineyard sound, (see sketch A,) and 2 at the entrance of the passages between Buzzard's bay and the sound, for currents, and 9 stations for tides. The tidal observations, during two lunations, were made at eight points as nearly identical as practicable with those at which partial results were obtained last year, and after this period two of the gauges were removed to points near the middle of the length of the passage, Quicks' and Wood's Holes, and simultaneous observations were again made.

Lieutenant Commanding Woodhull states, in his report:

"During the observations I had all due care and attention paid to the regulation of the time. I visited the stations frequently, to see that the duty was faithfully and carefully performed. The books have been well kept; observations of wind and weather have been made at all the stations. The barometer and thermometer have also been recorded with great care, both at Quicks' and Wood's Holes; in fact, I feel satisfied, as far as I could control circumstances, nothing has been neglected to insure favorable results. The tidal observations have been conducted agreeably to your directions in every respect, save observing them every hour for three consecutive days. I made all my arrangements to comply with your instructions in this particular, but did not succeed, owing to the constantly unfavorable state of the weather during nearly the whole of the time comprised in the two lunations."

The current observations made are thus referred to; (see also sketch A):

"In connexion with the above, the observations of currents received my attention, and, I think, will prove satisfactory. The currents were observed during the first lunation at Nos. 2, 15, 16, 17, 18, 19, and 20. On the second lunation, Nos. 3, 7, 10, 15, 16, 17, 18, and 19.

"When the stations were occupied the weather was calm, occasionally foggy, with a rather smooth sea. This state of the weather, though not highly favorable, was sufficiently so to ascertain the correct directions and force of the currents. Four consecutive tides were taken at each of these stations, two ebbs and two floods, and the velocity on the surface and fifteen feet below it. You will perceive I did not fail to take advantage of all the good weather that offered, and the results have been nearly twice that of last year, and four times as great as those of the year before."

The number of observations of tides was 2,817 during the year, and of currents 978 on 16 days.

Leaving the tidal observations in charge of a part of the officers of his party, Lieutenant Commanding Woodhull proceeded to Chatham harbor and made the preliminary survey to which I have already alluded.

The party next executed the soundings of the approach to Portsmouth harbor, New Hampshire, and of the intricate channel behind the navy-yard at Kittery, Maine. The area of the off-shore work was 77 square miles, extending to the Isle of Shoals; 231 miles were run in sounding, 4,150 casts of the deep-sea lead made, and 380 angles for position observed. Lieutenant Commanding Woodhull states that the irregularities of the bottom are such as to render the soundings of comparatively little value in determining the position of a vessel on this part of the coast in thick weather. The tides will be observed at Portsmouth during at least two lunations.

The harbor of Newburyport, Massachusetts, and the approaches, have also been sounded out, by this party, seaward, between three and four miles, and about two miles and a half on both sides of the entrance. "The inside work extends from the bar to about a mile and a half above the railroad bridge; in all, a distance of three and a half miles, varying from three-eighths to one-half a mile in width." The area embraced is 20 square miles, in which 7,500 casts of the lead have been made, 175 miles have been run in sounding, and 632 angles for position observed. Tidal observations will also be kept up at Newburyport.

Lieutenant Commanding Woodhull is now (October 15) under instructions to proceed to Connecticut river for the re-examination of the entrance, and the work done will be stated in his supplementary report.

In his report of the season's work, Lieutenant Commanding Woodhull pays a well-merited compliment to the zeal and industry of the officers of his party, through whom so large an amount of work has been accomplished.

SECTION II.—FROM POINT JUDITH TO CAPE HENLOPEN, INCLUDING THE COAST OF CONNECTICUT, NEW YORK, PENNSYLVANIA, AND PART OF DELAWARE.—(Sketch B.)

The field-work of this section has been of the usual miscellaneous character; parties being occasionally occupied, as they could best be spared from other sections, in filling up portions remaining unexecuted, or in revision where it has been found necessary. The office-work has advanced according to the estimates and plans for it at the beginning of the year; and the details will be found under the head of "Office-work" in this report. Eighteen finished maps and charts have been published of this section, (three of which during the year,) besides two sketches.

In the immediate necessity for practical results for our work, it is often expedient to postpone questions of interest, which have a less important bearing, and yet without the solution of which the survey will be incomplete. Of this character is the question of tides and currents at a distance from the coast, but within the limits proper to the hydrography, the form of the bottom of the sea, and the like. Sections were made two years since for the off-shore map, embracing the space between Gay Head and Cape Henlopen, which showed the curious result of the sudden and rapid slope of the bottom of the sea, after the depth of one hundred fathoms was reached. This year I have attempted the other question, and have given the necessary instructions for its solu-

tion at stations within the limits of the same chart, but the stormy character of the season has materially interfered with their execution.

This off-shore chart being the first of a series, the mode of arranging the details has occupied much attention; and each case requiring study, and not being a matter of routine, much more time has been unavoidably consumed than will be necessary in another chart. Successive improvements have been made, rendering the chart more valuable, but tending to delay the publication. It is now, however, certain that all the essential data for publication have been procured, so that a first edition can be issued; leaving those refinements which it is proposed to introduce till a later period.

The items in the light-house bill referred to me for examination, under the law of March 3, 1851, by the instructions of the Treasury Department, were the following:

“*Connecticut*.—For a can-buoy on Peafield reef, off Black Rock harbor, in Long Island sound, in addition to a former appropriation in the act of September, 1850, one hundred and thirty-five dollars.

“*New York*.—For a light-house on Flynn’s knoll, near Sandy Hook, thirty thousand dollars.

“For a light-house on the northern extremity of Gardiner’s island, six thousand dollars.

“For the completion of two beacons near Fort Hamilton, two thousand dollars.

“For a beacon on the Sand Spit, in the harbor of Sag Harbor, seven hundred dollars.

“For four spar-buoys at Fire Island inlet, three hundred dollars.

“*New Jersey*.—For a fog-bell at the Newark light-house, two hundred and fifty dollars.

“For the completion of the beacon in Passaic river, four spar-buoys in the same, a spar-buoy at Mill Rock, and a beacon at the Corner Stake, near Elizabethtown Point, eight hundred dollars.”

The spar-buoys for Fire island having been recommended by me on the report of Lieutenant Commanding Woodhull, the recommendation was simply repeated.

An examination of Flynn’s knoll by the Light-house Board, raised a doubt as to the expediency of placing a light-house on that shoal. I suggested the alternative of range-lights, similar to the one approved for the main ship-channel, from its elbow near the Southwest Spit shoal through the Narrows—(see report to the Secretary of the Treasury in Appendix No. 23;) one set of ranges to lead from the entrance from Gedney’s channel, through the main ship-channel, to the range for changing course to northward; another range to lead through the Swash channel, the importance of which cannot be exaggerated. The project includes the substitution of a beacon-light for the Elm Tree beacon. The two small beacon-lights required by this plan for the main ship-channel will be screened by the woods, through which the range lines will be cut at Point Comfort, (see sketch B, No. 5,) on the New Jersey shore; or artificially, so as to be seen on the range, and at a moderate distance on each side only. The same precaution will be taken in regard to the Swash range, so as to avoid confusion from multiplying the number of lights. A distinction of colors may also be in-

troduced with advantage. The first range requires the lights to be seen at from eight to ten miles, and the second at about six and a half and eight and a half miles. The beacon-lights at Fort Hamilton must be seen eight miles.

Items numbered nine (9) to nineteen (19) inclusive, were referred to Lieutenants Commanding Thornton A. Jenkins and Maxwell Woodhull, United States navy, assistants in the coast survey, for examination and report. On the information received from them I reported, (June 13,) recommending the buoy on Peafield reef, No. 9; a light-house on Gardiner's island (No. 11,) to show a red light; the beacon in Sag Harbor, (No. 12;) the two beacons near Fort Hamilton, New York harbor, (No. 13;) a fog-bell for Newark light; the beacons in Passaic river (No. 14;) and the beacon near Elizabethtown Point.

The four buoys (No. 14) in the Passaic river and the one on Mill Rock were found to have been already placed. An additional buoy off Black Rock harbor (Connecticut) was recommended, for which no appropriation had been made.

My report to the Treasury Department, together with the reports of Lieutenants Commanding Jenkins and Woodhull, are in the Appendix No. 24, and show the reasons for these recommendations. The maps referred to are published maps of the coast survey, which embrace the localities named, upon which the positions designed for the beacons and buoys were marked. No new surveys were required in these cases, but merely an examination of the localities with the charts in hand, by persons acquainted with the details of such work.

The different operations in this section will be briefly noticed in their order:

1. The triangulation of the Hudson river has been continued by assistant Edmund Blunt, aided by Lieutenant Joseph S. Totten, United States army, assistant in the coast survey, and during a brief period by assistant W. E. Greenwell. The connexion with the former triangles was made through stations Diddery and Buttermilk Hill; the scheme has been extended to Bear Mountain, (see sketch B.) This party, having supplied points for the hydrography of the entrance to the Chesapeake, was temporarily withdrawn from Section III, during the part of the season unfavorable for primary work there, and has made the following determinations: for primary triangulation 49 angles, and for secondary triangulations 213 angles, have been measured by 2,357 observations.

The work in the Chesapeake was resumed in November.

2. The following observations were made for the coast survey at the observatory of the Central High School, Philadelphia, by Professor E. O. Kendall, for longitude:

“Forty-five transits of the moon have been observed, of which twenty-nine were of the *first* limb, and sixteen of the *second*. In most cases four moon-culminating stars were observed, and as many of the fundamental stars as were necessary for the determination of the corrections of the instrument, and that of the clock. The number of occultations observed during this period is seven. This is a smaller number than usual; and it may not be improper to say, by way of explanation, that during the first half of this year (1851) the prevalence of cloudy

evenings was unprecedented, as far as my experience goes. The *beginning* and *end* of the solar eclipse of July 27 were successfully observed here by Mr. Riggs and Mr. Mason, the former using the nine-foot equatorial, and the latter the two-and-a-half-foot Dyalitic telescope.

"I have, also, with the assistance of Mr. Andrew Mason, completed the reduction and copying of all the observations made at this place up to the close of the year 1850, and have forwarded them to the office of the Coast Survey. The work of reducing the observations of 1851 is in such a state of forwardness that I shall be able to get them ready for your use soon after the close of the year. The results of those obtained from January to June inclusive, will, as requested, be sent to Washington in a few days, for comparison with Mr. Davidson's at San Diego." The closing remark refers to the immediate use of these observations in determining the longitude of the coast survey station at San Diego.

3. Assistant J. B. Glück executed in July the minute topographical surveys required to determine the location of range-lights for the main ship-channel and for the Swash channel into New York harbor. These were made at a very trifling expense in consequence of the kindness of the collector, Hugh Maxwell, esq., in permitting the use of the revenue cutter Taney, and of the promptness of Captain Rudolph in rendering us assistance. For Mr. Glück's report, see Appendix No. 23.

4. A re-survey has just been made of Sandy Hook for determining the changes in that point; and permanent marks, of a suitable kind, were placed, as recommended in a report of a previous year, by assistant H. L. Whiting, by which the changes may very readily be ascertained from time to time. The re-survey was made under the immediate direction of Mr. Whiting, by Mr. R. M. Bache. The results are shown in connexion with those of former years, on sketch B, No. 4.

5. The verification of the hydrography required for the third, or eastern, sheet of the chart of the south side of Long Island was executed at the close of May last by Lieutenant Commanding Maxwell Woodhull, United States navy, assistant in the coast survey, in the schooner Madison. The work extends from Neapeague to Montauk Point, (see sketch B,) and was carried out about nine miles from the shore. The area was 117 square miles, in sounding which, 332 miles were run, 4,800 casts of the lead made, and 422 angles for position measured. The party was then transferred to the Vineyard sound for tidal and current observations, which have been already reported in connexion with the other work of Section I. Professor Pendleton, United States navy, assistant in the coast survey, assisted in the measurement of angles from the shore stations, required in this work.

6. Deficiencies in the hydrography of the entrance to Connecticut river having been reported, Lieutenant Commanding Woodhull was instructed to proceed there early in the season, and after filling up the work required, and examining the bar at the entrance, recommended a re-survey, which was accordingly directed. On completing his work in Section I, (hydrography of Newburyport harbor, Massachusetts,) he proceeded to Connecticut river, of the entrance and bar of which he has made a careful survey. As soon as the soundings are plotted, sailing directions will be published, and the sheet reduced for engraving.

A record of the tides, day and night, was kept here.

7. The removal of certain of the reefs in the dangerous passage of Hell Gate having been resolved upon by enterprising citizens of New York, it appeared desirable that the reefs should be minutely examined before and after these operations, and that the changes in the hydrography of the passage should be carefully noted. Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, was detailed for this purpose, and made minute surveys of Way's reef, Pot Rock, the Gridiron, and Hallet's Point; the first two being made in October after the first blastings, and the second before any such operations had been attempted. For his reports, see Appendix No. 56.

To the perseverance and urgency of Eben Meriam, esq., of Brooklyn, the liberality of Henry Grinnell, esq., and others, of New York, and the skill of Mr. Maillefert in submarine blasting, the city of New York will owe an undertaking which has already so far succeeded as to render it almost certain that the dangers of this formidable passage may be essentially diminished, if not entirely removed.

The Coast Survey chart of Hell Gate, and its approaches, will be modified in accordance with the changes which may be developed, and the first edition will serve as a historical record of no small value and interest.

8. Lieutenant Commanding S. Swartwout, United States navy, assistant in the coast survey, was detached with the brig Washington, for a short time, to make the hydrographic survey of the vicinity of Cox's ledge, which is some twenty-one miles from Block island. Thirty-four miles of soundings were run over, and sixty-eight soundings procured, in from 16 to 24 fathoms water.

9. Valuable reports have been received from the Hon. H. C. Murphy, of Brooklyn, on the names upon the Coast Survey map No. 1, of Long Island sound, including both shores, giving the orthography and derivation of some 270 names. This is in continuation of his reports on sheets Nos. 2 and 3 of the same map.

10. In my report of 1849, I noticed the operations for determining, by telegraph, the difference of longitude of Seaton station (Washington) and Western Reserve College, with a view to render available for the longitude of one of the Coast Survey stations the elaborate series of moon-culminations observed by Professor Loomis, (now of New York University,) between the years 1838 and 1844.

It was found impracticable to transmit the signals to and from Washington, but from and to Philadelphia the telegraphic connexion with Hudson was complete on several nights during the time set apart for the work.

The telegraph and other observations have since been reduced under the direction of assistant S. C. Walker, who deduces from them the longitude of the observatory of Western Reserve College, Hudson, Ohio, west of the High School observatory, Philadelphia, 25m. 5.70s.

11. The results of the observations for difference of longitude between the Seaton station, Washington, and the High School observatory, Philadelphia, made in the summer of 1849, have been computed by assistant S. C. Walker, or under his immediate direction. They

consisted of the exchange of chronometer signals and of star signals, and, with the weights assigned to the different classes of observations by Mr. Walker, give the difference of longitude 7^m. 20.90^s.

SECTION III.—FROM CAPE HENLOPEN TO CAPE HENRY, INCLUDING THE COAST OF DELAWARE, MARYLAND, AND PART OF VIRGINIA.—(Sketch C.)

Seven land parties have been employed in this section during the season, either in whole or in part; one, a double hydrographic party throughout, and another for a portion of the season. The astronomical observations for connexion of the Capitol with the coast have been finished; and a scheme devised, after reconnaissance, for connexion of the Chesapeake with the seacoast triangulation. The primary triangulation of the Chesapeake has been extended from the limits of last year towards the Capes, at which some preliminary determinations have been made, embracing in area more than half of all that remained to be completed at the time of my last year's report.

The system of connexion, by telegraph, of Washington with distant points of the coast for difference of longitude, has been prosecuted. The secondary triangulation has extended along the peninsula of Virginia, from Cedar island to Rogue's island on the Atlantic coast. The topography of the Patapsco river has been revised. Other topographical surveys have covered part of the seacoast of the peninsula of Maryland and Virginia; and both shores, with the islands of the Chesapeake bay, in that portion including Pocomoke sound on the east, and lying between the Potomac and Rappahannock rivers on the west.

The hydrographic operations have advanced along the outer shore of Virginia, from a point in Maryland near the line, to within about forty miles of Cape Charles, including important shoals on the coast, and extending seaward a distance of about eleven miles. They have likewise been continued in Chesapeake bay; and a special survey, of which the results are made public in a sketch herewith, has furnished valuable information in regard to the approaches (middle ground) of that bay.

Astronomical observations, &c.—Causten's station, near Georgetown, D. C., was occupied during May and June by my party, for the determination of latitude and azimuth. Magnetic observations were also made, and an angle in one of the secondary triangles measured, to furnish a base for continuing the survey down the Potomac. The observations were made, under my immediate direction, by sub-assistant George W. Dean; and the following table shows their number and kind, and the instruments with which they were made:

Observations for—

Time.—Transit No. 4, (Troughton & Simms,) 102 observations on 12 pairs of stars.

Latitude.—Zenith sector, C. S. No. 1, (Troughton & Simms,) 366 observations on 80 stars.

Azimuth.—30-inch theodolite, C. S. No. 1, (Troughton & Simms,) 130 observations on Polaris.

Magnetic.—Variation, declinometer C. S. No. 1, by Jones, 77 observations on five different days; intensity, declinometer C. S. No. 1, by

Jones, 3 sets on three different days; dip, 10-inch dip-circle by Gambey, 3 sets on two different days.

The stars used in the latitude observations were selected from the Greenwich twelve-year catalogue, for which we are indebted to Professor Airy.

The micrometers of the zenith sector were compared with the divisions on the limb of the instrument, giving the same resulting mean value as was obtained last year.

The azimuths were in part observed at elongation and in part at culmination, by the method referred to in my last report. They were referred to a mark placed nearly in the line to Soper's station, (Montgomery county, Maryland,) and the angle between the mark and the signal at Soper's was measured by the micrometer.

During the months of July and August, moon culminations were observed at the Seaton station by Mr. J. C. Langton, under the direction of assistant S. C. Walker, by the galvanic method.* In his annual report, Mr. Walker brings up the results of the investigation of the rate of transmission of the signals through telegraph lines (galvanic wave time) to the present date. "The results of our experience to October, 1850, were then stated to be—

"1st. That the average of all our experiments to that time indicated a velocity of propagation of the galvanic wave of 15,400 miles per second in the iron wires of a telegraph line.

"2d. That the velocity of propagation through the ground appeared to be less than two-thirds of the velocity in the iron wires."

During the year, three new results have been added to the foregoing, two of them obtained incidentally while determining differences of longitude. The first, between the Seaton station, Washington, and Portsmouth, Virginia, when the distance through the wires was 268 miles, and through the ground 180 miles; the second, between Charleston, South Carolina, and Savannah, Georgia, passing through Augusta, the length of the circuit of telegraph wires being in this 447 miles. In the third, from Cincinnati and back, the circuit consisted of 840 miles of iron wire, there being no ground connexion. From a comparison of all the results, Mr. Walker draws the conclusion that the time of traversing 15,461 miles is one second. As these experiments have attracted much attention, at home and abroad, among scientific men, and afford the data for examination of questions in regard to the propagation of the galvanic influence which are of high interest, I have placed Mr. Walker's report, entire, in the Appendix No. 25.

The telegraphic operations for determining difference of longitude between Seaton station and Forbes' point, North Carolina, and the general arrangement for those between Charleston and Savannah, were under the charge of assistant Sears C. Walker. An account of these has been given, in the proper place, in Sections IV and V. In addition, he has been industriously occupied in reducing and superintending the reduction of his telegraph results, and of the longitude observations of others.

* This is termed by Mr. Airy, the Astronomer Royal of Great Britain, the "American method."

During the year, the telegraph work of 1846 and 1847 has been discussed by him, using the best values for personal equations, and he now reports the discussion as final.

The work of 1848, between Washington, New York, and Cambridge, has also been finally discussed, and the geodetic corrections applied. That between Philadelphia and Cincinnati, in 1849, Philadelphia and Hudson, and Seaton station and Charleston, in 1850, is also reported as complete; and the results of observations of moon culminations and occultations at Hudson, by Professor Loomis, have been used in determining the longitude of Cambridge.

The following extracts from Mr. Walker's annual report will show the progress of the computations of moon culminations, &c., under his charge:

"In the course of the last year additional corresponding moon culminations have been found for Mr. Hilgard's work at Sand key, Florida, Section VI, and reduced and reported.

"The observations of assistant Davidson, at Point Conception, Upper California, Section X, of moon culminations, have been reduced and compared with those made at Philadelphia and Cambridge. The longitude of Point Conception has been obtained and reported."

* * * * *

"No progress has been made in the further reduction of the collection of occultations and eclipses of the coast survey. I recommend that these be compared and reduced, with the recent improvements in the lunar theory, in particular including that of Mr. Myers Fisher Longstreth, of Philadelphia.

"The work of reducing the moon culminations of the coast survey has been continued by Professor Pendleton, with the assistance of Professor Yulee and Mr. Keber. Nearly all the work at Hudson, Ohio, has been revised; and in instances where Lieutenant Gilliss, United States navy, and Professor Loomis differ, a triplicate computation is made. A part of the work of Lieutenant Gilliss, United States navy, has been submitted to a duplicate computation.

"Professor Pendleton's work has been, thus far, limited to the years 1841 and 1846."

* * * * *

"Corresponding observations of moon culminations only have been hitherto reduced, in consequence of the state of the lunar theory. The recent improvements in that theory by Hansen, Airy, Longstreth, and Peirce, make it desirable to compare all our observed moon culminations with theory alone. Where corresponding observations are available, it is well to compare also with observation. It will serve as a test of the recent improvements, and may, perhaps, serve to throw some light on the discrepancy which now exists between the longitude by moon culminations and by chronometers.

"We are relieved from the necessity of reducing the numerous observations of the recent solar eclipse, by the amateur computations of Professor Peirce."

Referring to the results of the various chronometer expeditions, reported since 1844 by Mr. Bond, director of Harvard observatory,

including the special expeditions of the Coast Survey to Liverpool, Professor Walker remarks:

"I am convinced that there is no possible interpretation of them which will place the results below his reported value, $4h. 44m. 30.1s.$, for the longitude of Harvard observatory from Greenwich observatory.

"The longitude of Harvard observatory, by moon culminations at Harvard observatory, Dorchester, Hudson, Wilkes' observatory, and the Washington observatory, comes out very uniformly about $4h. 44m. 28.4s.$, leaving a discrepancy below the results by chronometers of $2.7s.$ This discrepancy will, I hope, be explained in time by persevering efforts."

Mr. Walker gives an abstract of his report on longitude, which will be found in Appendix No. 26.

A meteorological register was kept at Causten's station, by Mr. B. F. West, recording, for thirty-two days, observations for temperature of the air, moisture, atmospheric pressure, and the force, amount, and direction of winds and clouds.

Reconnaissance, primary triangulation, &c.—Major Henry Prince, United States army, assistant in the coast survey, made, during the earlier part of the season embraced in this report, an extended reconnaissance of the eastern shore of Maryland and Virginia—the purpose of which was to arrive at a mode of connecting the secondary triangulation of the Atlantic shore with that of the Chesapeake. The results of his examination show great difficulties in making the connexion high up the peninsula, for want of suitable natural elevations for signals, and on account of the heavy cutting involved in the use of any station on the main land. It therefore appears advisable, as it is reported practicable, to make the connexion by observing from island stations on either side—upon Drummondtown or some point where the peninsula is narrow—or to postpone the connexion until Cape Charles is reached by the Chesapeake and by the outside triangulations.

From this reconnaissance, Major Prince passed to that of Pamlico sound and others of importance.

Assistant Edmund Blunt, with a party for primary triangulation, was engaged in the lower part of Chesapeake bay for the greater part of three months, June to August; afterwards proceeding north for the triangulation of the Hudson river, and returning to this section in November. Mr. Blunt's operations in this section were the observations for triangulation and the reconnaissances appropriate to form a judicious scheme, and to establish points for hydrographical and topographical purposes. The triangulation of the season extends from Wolf Trap station (intermediate between York and Rappahannock rivers) south towards the entrance of Chesapeake bay, at which some preliminary determinations were made. A reference to the general sketch C, will show that it has adopted as primary points the principal capes and light-houses. Care was taken in all cases to mark the points used in a permanent manner for future reference.

The statistics of Mr. Blunt show 18 primary angles measured, and 67 others—in all, 136 series of angles were measured by 1,478 observations. The season's work covered an area of 400 square miles.

Secondary triangulation.—Assistant John Farley has continued this portion of the work along the outer coast of Virginia. His party, en-

gaged during October and November, 1850, and June, July, and August, 1851, suspended operations at the end of August on account of health, but returned to the field in October. In the intervals of withdrawal they have been occupied in the computation of previous work.

The triangulation has been continued (see sketch C) from Joynes' station, near Drummondtown, Accomac county, to Sand shoals, opposite Eastville, in Northampton county, Virginia, and within about 18 miles of Cape Charles. It covers an area of 150 square miles, "by the occupation of 10 stations, with 42 angles, and 1,100 intersections, on 51 lines of sight."

Mr. Farley adds that, at the request of the Fifth Auditor, Mr. Pleasanton, "a point has been incidentally established upon the public reservation for a light on Hog island, in Northampton county—subject to be received as the centre of the proposed light-house; which point, if accepted, will have determined the latitude and longitude of the same."

Assistant Farley was aided by Mr. George H. Bagwell.

Topography, (sketch C.)—Four plane-table parties (one of which was double) have been in the field during the available portions of the year. Their operations have been as follows:

1. After the date of my report of last year, and in April, May, and June of the present year, assistant J. B. Glück continued the revision of the topography of the shores of the Patapsco. His sheets comprise an area of 26 square miles, and an extent of shore-line of 98 miles. The Coast Survey schooner Nautilus was assigned as a means of transportation for his party. Mr. Glück is now (October 15) under instructions to return to this section for the completion of this work, which is essential to the publication of the chart of Baltimore harbor and the Patapsco river, already delayed by circumstances which could neither be foreseen nor controlled.

2. A double topographical party was in the field under sub-assistant John Seib until the latter part of December, 1850; was then occupied in office work, and resumed its field duties in May, 1851. Sub-assistant S. A. Wainwright returned to this party in August, having been meantime in section V. Mr. G. W. Parrish and Mr. John H. Wise have been aiding Mr. Seib. The party have had in use the Coast Survey schooner Wave. The topography executed this season in the Chesapeake bay, including the interior of the coast between the Potomac and Rappahannock rivers, extends over the latter, and along the shore to within a few miles of York river, and on the opposite coast covers the shore and islands from the immediate vicinity of the Maryland line southward to a point about 15 miles from Cape Charles. Mr. Seib's account of the progress and general character of the work is given more in detail, by reference to the numbers of the plane-table sheets, as follows, (see general sketch C):

Sheets Nos. 40 and 41, (western shore between the Potomac and Rappahannock rivers,) and Nos. 42 and 43, (eastern shore and islands of Pocomoke sound, and the neighboring portion of the Chesapeake,) were completed during the fall and winter of 1850.

Sheets Nos. 46 and 47 embrace the survey of the main shore of Chesapeake bay, from Windmill Point to Wolf Trap, the shore of the mouth of the Rappahannock, on the north for three miles, and or.

the south for two miles, with the topography of Hill's bay, Milford Haven, Gwinn's island, and Stingray Point. The country is slightly elevated, intersected by creeks, coves, and ponds, and thickly settled.

No. 48, embracing the main eastern shore of the Chesapeake bay, from Sandy Point to Rose Mary, furnishes its topography, and that of the creeks included. The country is in part even and swampy—in part sandy and slightly uneven. The banks along the main shore vary from five to twenty feet in height.

No. 45.—This sheet is completed, comprising the shores and topography from Sykes' island to Deep creek. A portion of this work was executed by Mr. Wainwright.

Mr. Seib furnishes the following statistics for the year :

Shore-line of bay, sound, creeks, and coves.....433 miles.

Area of country..... 91 square miles.

The office-work of the party (in which Mr. Seib and Mr. Wainwright were occupied during the winter and spring of 1851) consisted in inking and lettering the plane-table sheets of the previous season.

3. The statistics above given do not include the separate operations of sub-assistant S. A. Wainwright, who entered in August upon the topography of the eastern (Chesapeake) shore of Virginia, having been previously engaged in another section. His work for the season, up to October, is embraced in the plane-table sheet No. 45. It extends from Sykes' island to Guilford signal, along $44\frac{1}{2}$ miles of shore-line. Mr. Wainwright is going on with Pocomoke sound, and will pass, if practicable, to the western shore of Virginia, before the close of the season.

4. Assistant G. D. Wise, after closing his work on the coast of South Carolina, passed, May 8, to the survey of the Atlantic coast of Maryland and Virginia. The party was broken up about the first of July, by the sickness of Mr. Wise and some of his men.

The season's work is included between Lonesome Hill station, on the coast of Maryland, near the Virginia line, and Chincoteague inlet, Virginia, extending over fourteen miles of coast, along fifty miles of shore-line. The area embraced is twenty-five square miles.

Assistant Wise returned to the field, and took charge, October 15, of the party on the Atlantic coast of Virginia, whose operations I am next about to notice.

5. Mr. W. M. Johnson having been engaged from December, 1850, to June, 1851, in Section VIII, as aid to assistant Greenwell, and subsequently in office-work pertaining to that section, was transferred, August 12, to a party in Section III, (then under sub-assistant J. M. Wampler,) of which, in a few days after, he succeeded to the charge. His work, up to October, embraces Wallop's and Assawaman islands, and a portion of Matomkin, extending south to the point marked South Gargathy, on the seacoast of Virginia, running inland a mile and a half, or two miles, (far enough to give an accurate idea of the topography of the entire back country) and being the continuation southward of the work just reported as executed by assistant Wise. It embraces an area of 21 square miles, and extends along 65 miles of shore-line, and 6 of roads.

On the general character of this portion of the coast, Mr. Johnson remarks: "The main land is about twenty feet above the level of the

ocean, sloping gradually from the water's edge. Between the islands and the main land lies a body of marsh, intersected by numerous creeks, bays, &c., and which is overflowed at every high water."

Hydrography.—Lieutenant Commanding John J. Almy, United States navy, assistant in the coast survey, has prosecuted, during the greater part of the season, the outside hydrography of the seacoast of Virginia. The steamer Legaré and the schooner Graham, belonging to the coast survey, have been placed under his command for this service. The state of the season rendering it dangerous to continue outside work with the steamer, the vessel and party were transferred early in September to the hydrography of Chesapeake bay. The Graham being of such light draught as easily to secure shelter in the inlets, was left outside to do some filling up and finishing off with her boats—thence to pass to the bay, and carry on the inside soundings there.

The character and progress of the work may be gathered from the sketch C, No. 3, (on which it embraces the coast between the points marked Lonesome Hill and South Gargathy,) and from the following description by Lieutenant Commanding Almy:

"I have completed the outside work down to South Gargathy, and in a direction southeast by east from this point, a distance of eleven miles seaward, where the tops of the trees in a clear day can just be seen from the deck of the steamer—the land being very low about here. This makes for my outside work this season eighteen nautical miles of in-shore soundings by the coast to the southward; and twenty miles from the southeast point of outside soundings last year to their termination point of this year.

"The season's work has covered Chincoteague shoals, and been brought into smooth, regular soundings, which continue down to the Chesapeake bay. These Chincoteague shoals appear to be the terror of all navigators who have to pass anywhere near them; and frequent inquiries have been made of us respecting their survey. The soundings which embrace all of these shoals are now completed."

The hydrographic work in Chesapeake bay, resumed by Lieutenant Commanding Almy, September 20, was continued until late in November. Its progress is thus described, (see also sketch C):

"The soundings in Chesapeake bay have been entirely completed as far down as a straight line drawn—which is very nearly due east and west—from Windmill point, (point of triangulation,) on the west side of the bay. Then south of the east and west line, on the west side of the bay. The soundings have been completed as far down as Wolf Trap, (point of triangulation,) and on a line due east from this, as far as the meridian of $76^{\circ} 04'$, which is about two-thirds of the way across the bay from the west side."

The following statistics of the work are reported by Lieutenant Commanding Almy:

	<i>Seacoast work.</i>	<i>Baywork.</i>
Area sounded, out, square miles	286	247
Number of soundings made by steamer and boats		
in from 1 to 17 fathoms.....	31,052	28,610
Length of lines run in sounding, nautical miles....	1,192	849

Seacoast work. Bay work.

Number of angles taken for hydrographic positions		
by theodolites	4,589	2,187
Number of ditto by sextants	1,425	1,594
Number of current stations occupied	3	2
Number of current observations taken	129	255
Number of tidal observations made	2,662	1,187

In the outside soundings, 27 different specimens, and in the inside 13, have been obtained and placed in bottles, in duplicate, provided at the Coast Survey office. A sketch of the outside hydrography, executed by Lieutenant Commanding Almy, will be published immediately. From the indications afforded by the track of three bottles, which were thrown overboard by Lieutenant Commanding Almy at different times, with dates marked, and which have since been picked up, it would appear that there is a general southwesterly current setting along the eastern (Atlantic) coast of Virginia, but quite moderate in strength.

On his return from Section VIII, Lieutenant Commanding B. F. Sands, United States navy, assistant in the coast survey, was directed to commence the survey of the approaches to the Chesapeake; and the steamer Walker, which he had used in Louisiana, requiring repairs, the Coast Survey schooners Nautilus and Meredith were assigned for his work. The arrangements for the transfer of the crews of the vessels were made by the 13th of August, and the work continued until the close of September. The following extract from the report of Lieutenant Commanding Sands will show what has been accomplished: "As the season was so far advanced that it was not probable we would have much good weather to complete any particular part of the section, I determined to run as many lines of soundings as possible over the 'Middle Ground' between the capes, confining myself to the shoal water, as that part was least known, even to the pilots.

"The weather was not favorable to very extensive work—the easterly winds, prevailing, made it frequently too rough for sounding; but we succeeded in running two hundred and sixty-eight miles of soundings, and in making ten thousand two hundred and thirty-eight casts of the lead in an area of sixty-five square miles, which will show the general configuration of a part of that great thoroughfare hitherto so little known. The tides were observed at two stations, and two positions occupied for preliminary current stations; the weather preventing further observations upon the currents, as was intended.

"A short season of smooth weather would enable us to finish this interesting portion of the approaches to this extensive bay, a knowledge of which would be of the greatest importance to the commerce of the Chesapeake and James river. The unfavorable weather would not admit of so extended a survey as to enable me to make reliable sailing directions; but the publication of a preliminary sketch of the work done would prove interesting to the commercial community."

The recommendation with which the extract closes has been adopted, and the sketch will be reduced and engraved to accompany this report, (sketch C, No. 2.) It is due to Lieutenant Commanding Sands and his

officers to say, that though they had just returned from arduous service in the Gulf of Mexico, there was no abatement of zeal and industry in the prosecution of the new duty assigned to them, as, indeed, the statistics of the work just given most amply prove.

Light-houses, &c.—In accordance with the instructions of the Treasury Department, pursuant to an act of Congress, Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey, was directed to make an examination of the necessity for a light-house at Fishing battery, otherwise called Donaho's battery, in Chesapeake bay, near Havre de Grace, Maryland. His report, and my recommendation or the erection of a light-house, will be found in Appendix No. 27.

SECTION IV.—FROM CAPE HENRY TO CAPE FEAR, INCLUDING THE COAST OF THE STATE OF NORTH CAROLINA.—(Sketch D.)

Two parties for triangulation and one for hydrography have been employed, during the whole of the past season, in this section; and during a part of it, in addition, a reconnaissance party and two hydrographic parties. The secondary triangulation of the season covers the greater part of Currituck sound; and the tertiary extends from Hatteras light to a point south of Ocracoke inlet. A general reconnaissance of Pamlico sound has prepared the way for the main triangulation. With this was united an examination of Core sound. The hydrography of Albemarle and Croatan sounds, remaining from the previous year's work, and that of Roanoke sound, have been completed; as also, in part, that of Currituck sound. Oregon inlet, which opened in 1846, was re-examined, to ascertain its progress.

The reports of the officers engaged in these surveys contain matter locally and generally interesting, which will be mentioned or quoted in due connexion. Reports upon Cape Fear river and Beaufort harbor, in reference to location of lights and buoys, will also be presented in their place.

To obtain the difference of longitude of a point in this section from Washington, the telegraphic connexion with Portsmouth, Virginia, was used, and chronometers transported from thence to Forbes' Point, near Elizabeth City, in North Carolina. Portsmouth is an important locality in the geodetic operations of the survey, as the southern extremity of the arc of the meridian which passes northward over the Chesapeake to the Delaware, and the measurement of which has now nearly been completed in the regular progress of the survey.

The drawing of one sheet of the general chart of Albemarle sound has made considerable progress, and that of Beaufort harbor is complete, and ready for engraving. Sketches of Hatteras shoals, Hatteras inlet, and Beaufort harbor, accompany this report, and provision has been made for engraving those of the entrance to Cape Fear, and the Fryingpan shoals off Cape Fear, as soon as sent in to the office.

It appears from the examination of Pamlico sound that it contains a number of excellent harbors, often needed for refuge, yet scarcely used from want of acquaintance with their intricacies.

The channel of Core sound, sounded in accordance with a special request of the legislature of North Carolina, was found to have undergone no substantial change.

Oregon inlet, which has been watched with interest as holding out hopes of a new entrance important to the navigation of Albemarle and Pamlico sounds, does not, in its present state, afford much encouragement to such an idea.

The harbor of Beaufort appears to be less liable to deterioration than other points on this part of the coast, and may be pronounced equal, in its security and natural facilities, to any port of our eastern coast south of the Chesapeake. It allows 17 feet to be carried in at low water.

A survey has been made of the Fryingpan shoals, (of which there appears to have been heretofore but little correct knowledge,) and of the approaches to the bars of Cape Fear river. The description of the shoals and channels, and the recommendations on the subject of lights and buoys, resulting from this examination, will be found at length under their proper head. A survey of Cape Fear river, interior to this, is also in progress.

An examination of Hatteras inlet has been made, in reference to which it is reported that "No important perceptible changes had taken place on the bar or in the channel, except near the anchorage; the sand and spits had become better defined, and the area of the anchoring ground had increased, with a greater depth of water as far as the bulkhead. No greater depth of water over the outer bar and on the bulkhead was found."

The deep-sea soundings and soundings for temperatures in the Gulf Stream have been prosecuted during the season in this section.

Astronomical, telegraphic, and chronometer observations.—These were under the charge of assistant Sears C. Walker. The scheme as organized was to determine the longitude of Portsmouth, Virginia, by the aid of telegraphic connexion with the Seaton station at Washington city, and from the former to deduce that of Forbes' Point, a station about forty-five miles distant, by the daily transportation of chronometers. In preparation, the chronometers had, for six weeks, been daily compared and rated by transit observations at Washington. Assistant Pourtales and Mr. J. R. Offley conducted the chronometric expedition, comparing night and morning, by coincidence of beats, the chronometers daily exchanged between Portsmouth and Forbes' Point. The former made the transit observations at Forbes' Point, and Mr. J. C. Langton those at the Washington station. Assistant Walker superintended the exchange of clock signals on the Seaton chronograph. The observer at Portsmouth tapped on the break-circuit key every five seconds for one minute, for each chronometer, and the hour and minute thus tapped were noted, the signal being registered by the instruments at Portsmouth, Petersburg, and Washington.

During seven days the success of the observations and exchange of signals had been amply favorable, when their progress was temporarily arrested by prolonged failure of the telegraph line after a storm. The operation was continued as far as the means at our disposal and the other exigencies of the season's service permitted. It is not considered, however, as completed.

Reconnaissance, (sketch D.)—The party and vessel employed in the tertiary triangulation were, for about six weeks, withdrawn from that duty and assigned to the use of Major H. Prince, United States army,

assistant in the coast survey, who made the reconnaissance and accompanying sketch of the sound usually known as "Pamlico." Major Prince refers to good maps, to the usage of the neighborhood, and to the oldest authorities, as condemning this orthography, and gives *Pamplico* as the name which appears to have the weight of authority in its favor.

Describing this sound, Major Prince says: "Its breadth from Roanoke island to Long shoal increases from nine to eighteen miles, and in the rest of its length it has a general breadth of from twenty to thirty miles. The general depth of the channel is from three to four fathoms." He notes the fact mentioned by Williamson, a historian of the State, forty years ago, that lands then planted with corn were covered with water at the beginning of the eighteenth century; and observes that if the same causes, whatever they may be, continue to operate, there will be large tracts of the richest possible soil reclaimed for cultivation along this coast. A growth of small live-oak about Ocracoke, it is remarked, vigilantly preserved, protects the soil from the action of the winds.

The exposure of this sound is such that navigation is often dangerous, and vessels have to put back some distance for refuge. Yet the desired harbors are reported to be numerous and convenient, and, to be useful, require only to be made known.

With reference to Core sound, the supposed changes of which had caused the legislature of the State to request its examination, Major Prince reports that he has carefully compared it with the chart of a survey made by Captain T. J. Lee, United States topographical engineers, in 1837. The result is thus stated: "A few small differences of soundings, (we having no tidal observations,) and some small differences of the course (allowance being made for some dredging, of which I have no account, on Piney Point shoal)—in the main, leave the present channel and that of the chart, as it was fourteen years ago, alike."

The sketch by Major Prince, above referred to, shows the scheme for the main triangulation obtained by his reconnaissance.

Secondary triangulation, (sketch D.)—In the season of eight months, (November to July,) assistant J. J. S. Hassler extended this branch of the work along Currituck sound, from Thoroughfare island to the Virginia line. The area embraced was 73 square miles; 12 stations were occupied, and 11 determined; and 871 angles measured by 5,226 observations. The party had the use of the Coast Survey schooner Vanderbilt.

A secondary triangulation, and the requisite topography connected with it, of the entrance to Cape Fear river, was executed by assistant Charles P. Bolles, aided by Mr. J. W. Gregorie, and the results immediately computed and furnished to the hydrographic party working at the same point. A preliminary base, rather exceeding three miles in length, was measured with a chain upon the beach. (See sketch D, No. 6.) From its extremities nearly every important point in the harbor can be seen, and "the triangles are so disposed as to give double determinations of nearly every point of the second order, and of every point of the third order." The work covers an area of 33 square miles; 8 stations were occupied, and 97 angles, on 17 objects, measured with a six-inch repeating theodolite by Gambey, (C. S. No. 35.) The plane-

table survey connected with it furnished 52 miles of shore line, and included the town of Smithville.

The party of assistant Bolles had already been engaged in section V, and were transferred to this section in June, remaining until the close of September.

Tertiary triangulation, (sketch D.)—A party, under sub-assistant A. S. Wadsworth, aided by Mr. C. T. Jardella, with the Coast Survey schooner Bancroft, was engaged in this triangulation from early in December until late in March. It was then withdrawn for use in reconnaissance, and, after some weeks, again occupied, for a short time, in marking with granite posts the most important stations of the preceding year.

The triangulation extended from Cape Hatteras to Ocracoke inlet, 35 miles along the coast, and covered an area of $97\frac{1}{2}$ square miles; 19 stations were occupied and 77 angles measured, by 450 observations, with a six-inch repeating theodolite of Gambey, (C. S. No. 29.)

Topography, (sketch D.)—Assistant Henry L. Whiting spent a month, with a party and vessel, in a topographical survey of the harbor of Beaufort. His work will, in connexion with other surveys, furnish a complete harbor chart. For the gratification of those specially interested, I annex descriptive extracts from his report. (See Appendix, No. 28.)

The amount of work accomplished may be thus stated: Area, in square miles, 22; extent of shore line, 39 miles; outline of shoals, &c., 15; length of creeks, 18; and of roads, 16 miles.

Assistant Whiting points out the causes which, in his opinion, tend to preserve the interior of this harbor from change, and the same general depth of water on the bar. These will be found in the Appendix, as above referred to; though I am not prepared to endorse the views expressed in reference to currents caused by Cape Lookout.

Hydrography.—(See the several sketches.)—Lieutenant Commanding Richard Wainwright, United States navy, assistant in the coast survey, with the surveying schooner John Y. Mason, was engaged in this section during the latter part of 1850, and from April to June, 1851. The hydrography of Roanoke and Croatan sounds, with the small portion of Albemarle sound remaining from last year, has been completed, and that of Currituck sound carried north, as far as the points marked Woodis and Willet's on the sketch. Thirty-three thousand eight hundred and seventeen soundings were made; 1,066 angles taken; and 496 miles of soundings run; nearly all done in boats.

Lieutenant Wainwright also visited Oregon inlet. He found the breakers extending entirely across the bar. The bulkhead towards Albemarle sound remains unchanged, having about three feet of water at mean tide.

Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, with the hydrographic party under his command, (which has been for the most part employed in Section V,) visited this section in December last to complete the hydrography of Beaufort, North Carolina; and has furnished a chart of the bar and harbor. (Sketch D, No. 5.)

The statistics of this supplementary work in Beaufort harbor are as

follows: 53 miles sounded over by 1,289 soundings; 88 angles measured; 36 specimens of the bottom obtained; and three sets of observations were made upon currents.

The same party returned to this section and undertook, in October of this year, the hydrographical reconnaissance of the entrance to the Cape Fear and of New river, North Carolina. The lateness of the season prevents their results from being received in time to be embodied in this report.

Tidal observations have been made at Smithville (Fort Johnson wharf) day and night, since July 1, and five current stations have been occupied.

Lieutenant T. A. Jenkins, United States navy, assistant in the coast survey, commanded another hydrographic party, in the Coast Survey steamer Corwin. His operations have been directed—1st, to the re-examination of Hatteras inlet, to place it on the sheet of Hatteras shoals by the aid of the extended triangulation, and to ascertain whether any important changes had taken place; the results have been already indicated, (see sketch D, No. 3:) 2d, to the deep-sea soundings and soundings for temperatures in the Gulf Stream, (sketch D, No. 4:) 3d, to the survey of Fryingpan shoals and the approaches to the main and New Inlet bars at the mouth of the Cape Fear river, (sketch D, No. 8.)

The statistics of his season's work are as follows:

Area of hydrographic sheet.....	250 sq. miles.
Number of soundings taken.....	21,990
Number of angles measured.....	4,300
Number of lines of soundings run.....	313
Number of miles of soundings.....	540
Number of specimens of bottom preserved.....	46
Number of lines of deep-sea soundings run.....	2
Number of miles of deep-sea soundings run.....	125
Number of positions for deep-sea soundings and temperatures in the Gulf Stream.....	4

The report of Lieutenant Commanding Jenkins on the Fryingpan shoals, and his suggestions in reference to the facilities required for navigation, are of such interest that I extract them in full:

“The Fryingpan shoals—extending from the southeast point of Cape Fear, in almost a SSE. direction from Bald Head light-house to the distance of twenty nautical miles, to ten fathoms water, with an average width of four miles—and the approaches to the main and New Inlet bars at the mouth of the Cape Fear river, have been carefully surveyed, and the sheet is now nearly ready for reduction to the publication scale.

“The pilots and others in the vicinity had little correct knowledge of these dangerous shoals, and the great distance to which they extend from the shore rendered the work one of more than ordinary difficulty.

“The shoalest spot outside of Bird shoal, (near the point of the cape,) has 7, 8, and 9 feet water on it at low water, distant 13 nautical miles from Bald Head light-house, and bearing NNW. from it by compass.

“There is another shoal spot with ten feet water at low tide, 14½

nautical miles from Bald Head light-house, and bearing NNW. $\frac{1}{2}$ W. from it. Two small shoal spots, 16 and 18 miles from light-house, with 16, 17, and 18 feet water on them at low water, bearing SSE. $\frac{1}{2}$ E. to SE. by E. from light-house. The sea breaks on these shoals, except in very calm weather.

"Bald Head light-house bears by compass NW. $\frac{1}{4}$ N. from the eastern point of the Fryingpan shoals, in 6, 7, and 8 fathoms water; coarse gray sand, broken shells, and pebbles, at the distance of twenty nautical miles.

"Bald Head light-house bears per compass NW. by N. from the southeastern point of the Fryingpan shoals, in 8, 9, and 10 fathoms; fine gray sand and black specks; distant twenty nautical miles.

"Not less than 16 feet water will be found outside of the ten-foot shoal, which bears SSE. $\frac{1}{2}$ E., distant fifteen nautical miles from the Bald Head light-house.

"The bottom is well marked on either side of the shoals. On the west side, and at the southeastern extremity of them, fine gray sand with black specks will be found. On the eastern and northeastern side of them broken shells, coarse sand, pebbles, and occasionally small pieces of coral.

"A line made good, SSE. by compass, from the main bar of Cape Fear, will clear the western edge of the three-fathoms curve of the shoals.

"Vessels bound around the shoals to the eastward from the bar should steer out S. by E. to the distance of sixteen to eighteen miles, in eight to ten fathoms water, when an east course will pass on the outer part of the shoals in three fathoms to seven fathoms water.

"These shoals may be said to be continuous from the point of the cape to ten fathoms water, although at the distance of fourteen nautical miles, Bald Head light-house bearing NNW., there is a channel running SW. by S., and NE. by N., of upwards of a nautical mile in width, through which a depth of three and half to five, six, and seven fathoms water may be carried at low tides; but the shoals on either side, with only seven, eight, and nine feet to the northward, and ten feet to the southward and eastward, and nothing but the compass and lead to guide the navigator, in the absence of a light-vessel or buoys, render it too dangerous to be available.

"Vessels drawing not more than nine and ten feet water can cross the shoals at low water by steering ENE., and WSW., at the distance of three to four nautical miles from the point of Cape Fear; and there is a channel between the distances of five and a half to eight and a half nautical miles, through which vessels drawing ten and a half and eleven feet can pass with perfect safety at low tide; the channel is three nautical miles wide, and with the exception of two or three small spots of ten and a half and eleven feet water, thirteen to fifteen feet will be carried through it; the courses are from NE. to ENE., and SW. to WSW.

"At a point of the shoals (Bald Head light-house distant eleven nautical miles, and bearing N. by W. $\frac{3}{4}$ W.) there is a channel of two and a half fathoms water, upwards of a nautical mile wide. It is in

length only one-third of a mile across the shoal, running NE. and SW.

“Two large iron buoys, properly marked, placed, and moored with heavy moorings, or with Mitchell’s screw, would render this channel one of great value, not only to the local trade of the Cape Fear region, but to the coasting trade in general, along the southern coast.

“Any vessel capable of crossing either bar at the mouth of the Cape Fear river, would find no difficulty in crossing these shoals under ordinary circumstances of weather and sea, when these channels shall have been properly marked out by large buoys, enabling those threatened by bad weather to make a port under almost every condition of weather.

“Too much importance, it is believed, cannot be attached to the subject of marking, as perfectly as may be possible, the channels over these dangerous shoals, for the benefit of the coasting trade, and of furnishing means by which to guide the navigator bound north or south in passing outside of them.

“Two large iron buoys are required to mark the best channel over these shoals for coasters.

“The present light-house at Bald Head (said to have an elevation of one hundred and ten feet above the level of the sea) is inadequate as a seacoast light to the wants of the mariner. It is of comparatively little use now, owing to two causes: its great inferiority in brilliancy and intensity, and its bad location, being three and one-third nautical miles from the point of the cape.

“The outer part of the shoals is twenty nautical miles from the light-house, and seventeen from the pitch of the cape.

“Assuming that the present light can be seen as far as the curvature of the earth will permit, (which is not the case,) from the deck of an ordinary merchant vessel, the range in good weather will be fifteen nautical miles—five nautical miles short of the required range to reach the extremity of the shoals.

“To render a light efficient here, it will be necessary to change the location to a position as near the end of the cape as safety and prudence will permit; give the tower an elevation of not less than one hundred and fifty feet, and place in it a first-order dioptric apparatus, combining all the most recent improvements.

“An elevation of one hundred and fifty feet will give an ordinary range from the deck of a merchant vessel of nineteen to twenty nautical miles, leaving the mariner two or three miles on the safe side of the dangers.

“At present the fleets of vessels passing daily these dangerous shoals have nothing but the lead to guide them around them, while contending with currents, which are to a great extent, if not wholly, influenced in strength and direction by the winds.

“The removal of the present Bald Head light-house would work no disadvantage, as it is too far inland for a seacoast light, especially with its present apparatus; and is of very little, if of any, use in a local point of view.

“Until the present light-tower can be removed to its proper location, and a first-order lens apparatus be procured for it, a large light-vessel

ought to be built and placed in the slue, at the distance of fourteen nautical miles from the present light-house. If this vessel is fitted with proper parabolic reflectors and argand burners, and distinguished in a manner to prevent mistakes, it will contribute greatly to the security of life and property, and enable navigators, bound either north or south by this point, to shorten their passage by running boldly, when now they are compelled to creep along with the lead constantly going."

Light-houses, beacons, buoys, &c.—The providing and placing the bell-beacon and iron-buoy, off Cape Hatteras, having been intrusted, by the Secretary of the Treasury, to the Coast Survey, a contract has been made for them to be delivered in the spring of 1852, the earliest period at which it was deemed safe to place them.

In the Appendix (No. 29) will be found a report upon the subject of lights and buoys for Beaufort harbor, North Carolina; also, in the Appendix, (No. 30,) a report upon the necessity for a light-house on the Upper Jettie, Cape Fear river, North Carolina. In regard to the former, Lieutenant Commanding Maffitt observes, that if the lights and buoys be placed as recommended, vessels will enter the harbor in safety, by day or night, without a pilot.

The suggestions of Lieutenant Commanding Jenkins, United States navy, assistant in the coast survey, in reference to lights and buoys in the vicinity of Hatteras shoals, have just been given in full under the head of hydrography.

SECTION V.—FROM CAPE FEAR TO THE ST. MARY'S RIVER, INCLUDING THE COAST OF THE STATES OF SOUTH CAROLINA AND GEORGIA.—(Sketch E.)

In this section two parties have been in the field engaged in triangulation and two in topography, besides the party employed upon the hydrography. The operations have been as follows:

1. Astronomical observations at Savannah, and the preliminary triangulation of the entrance to Savannah river. (See sketch E, No. 2.)
2. The connexion of Charleston and Savannah for difference of longitude by telegraph.
3. The triangulation of North Edisto river, South Carolina. (Sketch E, No. 3.)
4. Secondary triangulation of St. Helena sound and the South Edisto and Ashepoo rivers, extending from Edisto island on the north to the Hunting islands on the south, coast of South Carolina. (Sketch E, No. 3.)
5. A topographical survey of North Edisto river. (Sketch E, No. 3.)
6. A similar survey of part of Savannah river. (Sketch E, No. 2.)
7. Completion of the hydrography of Charleston bar, approaches, and harbor. (Sketch E.)
8. Hydrographic reconnaissance of Savannah river and bar. (See sketch E, Nos. 4 and 5.)
9. Hydrography of North Edisto bar and river. (Sketch E, No. 7.)
10. Tidal observations day and night at several stations.

A map of Charleston harbor, on a large scale, has been engraved, and will be published at once.

A chart of Savannah bar and another of the harbor, with the "Main," "Front" and "Back" rivers, have been furnished to the office, and are engraved and nearly ready for publication. The plate of the chart of Bull's bay, on the coast of South Carolina, northeast of Charleston harbor, is in process of re-engraving. (See sketch E, No. 6.)

The chart of North Edisto river and harbor of refuge is put in hand for engraving, and will be published as early as practicable.

At the request of the Chamber of Commerce of Charleston, and by authority of the Treasury Department, a copy of the Charleston harbor map, on a large scale, has been executed, and will speedily be furnished to that body. (See Appendix, No. 30 *bis*, for correspondence.)

After a fair trial in this section, it has been found expedient to cause the secondary, and in some cases the tertiary, triangulation to precede the primary. The greatest difficulty in the primary work is the preliminary tracing, through woods and swamps, and the cutting. The secondary and tertiary work following the circuitous course of the streams, and availing itself everywhere of continuous natural or artificial openings, affords means of running the primary lines from point to point with approximate accuracy, and of correcting readily any errors which occur in running. In executing this triangulation on and near Edisto island, and along the rivers which intersect it, parts of the base of the primary triangulation, which had been marked in the measurement, have been used, as convenience suggested, for the bases of the secondary work.

The difference of longitude of Charleston and Savannah was determined by telegraph, the line having been kindly placed at our disposal, after business hours, by the president of the company, Elam Alexander, esq. At the Charleston end the observations were made by Professor Lewis R. Gibbes, at his observatory; and at the Savannah end by assistant C. O. Boutelle. This connects the Seaton station at Washington with Savannah, the difference of longitude of Charleston and Washington having been determined in our operations of the previous year.

A full report of the computations of the observations by which the difference of longitude was obtained, between Professor Gibbes' observatory, in Charleston, and the Seaton station, at Washington, has been made by assistant S. C. Walker. The mean result is, Charleston west of Washington $11^m. 45.27s.$, with a probable error of $\pm 0.02s.$

In April last I visited the parties in this section for the inspection of their work, and to arrange the details of instructions to the topographical and hydrographic parties in Savannah river. The work was obviously advancing very satisfactorily, and the difficulties which attended its beginning were giving way before the increased experience of those engaged.

The kindness received from the gentlemen near whose residences the operations of the parties bring them, and the facilities uniformly extended in the execution of the work, in many cases at a considerable sacrifice of personal convenience, are acknowledged by all the parties in their reports. As a public acknowledgment by name might be deemed intrusive, I take this method of returning the best thanks of those employed in this section of the survey.

Astronomical Observations.—The observations for time, latitude, azimuth, and difference of longitude from Charleston, at the Exchange of Savannah, were made by assistant C. O. Boutelle, aided by Lieutenant Joseph S. Totten, United States army, detailed for coast survey service; and during a brief period by Professor E. Yulee. An astronomical clock by Kessels had been converted by Mr. Saxton into a circuit breaker, and was used for the observations of local time and for transmission of telegraphic time signals to Charleston. The transits of sixty-five stars were telegraphed to Charleston, and of fifty-eight were received from thence. They were usually observed on all the twenty-five wires of the diaphragm, and all were recorded on the Morse registering fillet. Two hundred and forty transits of sixty-five stars were observed for local time and deviation. The transit instrument was one of those of forty-five inches focal length, by Troughton & Simms, (C. S. No. 4,) with a diaphragm of twenty-five wires, by Würdeman, of Washington.

The observations for latitude were made with a new zenith telescope by William Würdeman, of Washington, (C. S. No. 5,) which is spoken of in terms of commendation by Mr. Boutelle. Seven hundred and forty-six observations were made on one hundred and twenty-six stars, paired according to Talcott's method. The values of the micrometer and level scales were duly determined, the former by observations on Polaris at elongation, a method first proposed and used by Mr. Boutelle.

The azimuth observations were made, by the kind permission of the mayor of the city, from the cupola of the Exchange. The instrument used was a twelve-inch theodolite by Gambey, (C. S. No. 30.) The results are recommended by Mr. Boutelle for adoption in the secondary triangulation only.

Professor Lewis R. Gibbes has observed at the Charleston observatory during the past year, for the coast survey, 39 moon culminations, and 95 transits of moon culminating stars, and six occultations. In connexion with these, 54 observations have been made, with reversal, on circumpolar stars, and on 130 zenith and equatorial stars, for time and instrumental corrections. In the telegraph operations for longitude, 52 stars were telegraphed on 1,220 wires. The importance of keeping up the observations at various points, so as to be sure of corresponding observations with those on the western coast, for longitude, is very great. It secures a clear night for observing, at some one point, when the positions are scattered over a considerable range of country.

Primary triangulation, and secondary connected with it.—The operations were under the charge of assistant C. O. Boutelle, aided, during part of the season, by Lieutenant Joseph S. Totten, United States army, and during nearly the entire season by J. W. Gregorie, esq. They were commenced by the triangulation of the North Edisto river, (see sketch E, No. 3,) in which nine stations were occupied, and 104 angles measured, on 86 objects, by 785 observations with an eight-inch Gambey theodolite, (C. S. No. 2.) The services of Mr. Boutelle being required at Savannah, this triangulation was completed by Mr. J. W. Gregorie, who retraced and opened several lines, and erected signals for the primary triangulation. In March, Lieutenant Joseph S. Totten made a reconnaissance for the triangulation from the Edisto to the

Stono river, inside of, and parallel to, the sea-beach. The reconnaissance made by Mr. Gregorie up the Dawho to Aiken's station on Jehossee, and along the Wadmelow river to New Cut, is shown upon the sketch—(sketch E, No. 3.) Mr. Boutelle remarks: "I make it a point to avoid extensive cutting in secondary triangulation, and it is a matter of much difficulty to get triangles of proper form without it. The houses along the river aid us much in carrying out our schemes of triangulation; and I cannot too often express the obligation we are under, for the uniformly friendly and courteous manner in which our requests to be allowed to erect signals and place instruments upon them are complied with."

Two primary stations, viz: the east and west ends of the base, were occupied by Mr. Boutelle for the measurement of horizontal angles, and at one (east end of the base) azimuths were measured. The observations were made with a theodolite by Würdeman, (C. S. No. 30.) It was found absolutely necessary to employ heliotropes in order to obtain a sufficient number of observations without a long delay.

In the entire work, of both classes, executed by this party, from taking the field in December to the close of the season in May, 15 stations were occupied, and 173 angles measured, on 158 objects, by 2,073 observations. This is in addition to the astronomical determination at Savannah, already noticed. The work was continued as long as the means provided for this particular party permitted.

An examination for points of triangulation for the entrance to Savannah river, to be used by the hydrographic party in sounding out Tybee bar, was made by assistant Boutelle in March, and it was intended that he should execute this operation personally; but having been temporarily disabled from work by an accident occurring after his party at Edisto had been discharged, the triangulation was made under his direction by Mr. J. W. Gregorie. The preliminary work intended for immediate use in a hydrographic reconnaissance is shown on sketch E. Twelve stations were occupied, and 218 angles measured, on 33 objects, by 383 observations. The operation was closed on the 3d of June.

The results of the triangulation of North Edisto river were furnished to the topographical party surveying those shores, and those of the Savannah river to the hydrographic party sounding the entrance and harbor.

The great activity of the party under Mr. Boutelle in field-work has involved a corresponding amount of office-work, in which he has, except during brief intervals of field duty which have been elsewhere stated, been laboriously engaged. In these computations he has been assisted by Messrs. G. A. Fairfield and J. R. Offley. Lieutenant J. S. Totten was, on the closing of the field-work in this section, attached to the party of assistant Edmund Blunt in Section III, (Virginia,) and Mr. J. W. Gregorie to that of assistant Bolles in Section IV, (North Carolina.)

Secondary triangulation.—The secondary triangulation executed by assistant Charles P. Bolles is shown in sketch E, No. 3. It rests upon a portion of the base on Edisto island measured for the primary work, and, gradually widening out, covers the South Edisto and Ashepoo rivers, and St. Helena sound, furnishing a very well conditioned scheme of work, and well selected points for the use of a topographical party.

Assistant Bolles commenced this work in February, and closed operations in May; he was assisted in it by sub-assistant George A. Fairfield, and during part of the season by S. S. Pendleton, esq. It was carried on under disadvantageous circumstances from the illness of Mr. Bolles, and yet presents a considerable amount of work. The area embraced is 35 square miles, 12 stations were occupied, and 115 angles measured, on 24 objects, by 978 observations, with a six-inch repeating theodolite by Gambey, (C. S. No. 35.)

Soon after closing this work, the services of assistant Bolles were called for, to execute the secondary triangulation, already referred to, at the entrance to Cape Fear river, North Carolina. He is now under instructions to complete the triangulation of the Savannah river, already commenced, and to carry the work, which has just been described, southward and westward, towards Beaufort, South Carolina.

Topography.—Assistant George D. Wise was engaged, with a plane-table party and the surveying schooner Franklin, upon the topographical survey of North Edisto river and harbor of refuge, South Carolina, from February 12 to April 18, when himself and party were transferred to the seacoast of Virginia. He was aided by J. A. Denny, esq.

Both shores of the river are embraced in this survey, (sketch E, No. 3,) which covers 40 square miles in area, and extends along 100 miles of shore-line and 44 of roads.

The base measured in 1850 on Edisto island furnished marked points, which were made available for the topographical survey.

Sub-assistant S. A. Wainwright, with another party, during the two months ending June 7, was employed in the topographical survey for a harbor chart of Savannah river. His work has established the points used by Lieutenant Commanding Maffitt, United States navy, for the hydrography—from Elba island to Argyle island, on both sides of Hutchinson's island, including eight and a half miles of shore-line; from Elba island to Savannah city, (comprising the wharves,) on the south side of the river; and from Elba island to a little below the south base signal on the north side, (see sketch E, No. 2.)

From this section Mr. Wainwright and party were transferred to work along the eastern shore of Virginia.

Hydrography.—Lieutenant Commanding J. N. Maffitt, United States navy, with the Coast Survey schooner Gallatin, (after being a few days employed in Section IV,) returned to this section December 12, 1850. He resumed the survey of Charleston bar and approaches, and in about one month completed the soundings requisite for the chart of that harbor. Thence he passed to North Edisto inlet, South Carolina, and, after much interruption from boisterous weather, finished, March 5, 1851, the hydrography of that river and bar, (sketch E, No. 7.) In the Appendix (No. 30 *tris*) are sailing directions, which have been published, furnished by Lieutenant Commanding Maffitt, for the entrance into that harbor of refuge. "It is about sixteen miles to the southward and westward of Charleston light-house, and is easy of access, one course over the bar taking the vessel to a safe anchorage. At mean low water there are thirteen feet on the bar. The mean rise and fall is six feet."

The hydrographical reconnaissance of Savannah bar and river was next undertaken; the shore parties co-operating being furnished with

a boat's crew from the vessel. The work, completed June 4, extends from one mile outside of the outer bar buoy, embraces the "Main," "Front," and "Back" rivers, and terminates at Argyle Tree, six miles above the city of Savannah, (sketch E, Nos. 4 and 5.)

The statistics of the work in this section are as follows:

Number of observations of angles.....	2,069
Number of soundings.....	60,001
Miles sounded over.....	1,237
Number of specimens taken of bottom.....	95
Number of sets of current observations.....	14

From the Savannah river Lieutenant Commanding Maffitt returned to Section IV; and, after necessary delays for repairs of vessel and shipment of a crew, entered on the reconnaissance of the bars of Smithville and New river, North Carolina.

A permanent tide-gauge was erected at Fort Pulaski, entrance of Savannah river, where careful observations, day and night, of the tides have been regularly made since January.

A permanent tide-gauge has also been erected at Castle Pinkney, in Charleston harbor; but circumstances have not heretofore permitted tidal observations to be made with the same regularity.

At North Edisto inlet the tides were observed, day and night, for eight weeks.

Besides their field-work, Lieutenant Commanding Maffitt and party have completed and turned in the following office-work, in mapping their results, viz:

A chart of Charleston bar and harbor.

Another of the same bar and approaches, with additional work on Rattlesnake shoals, which was off the limits of the original sheet.

A chart of Savannah bar, from one mile outside of the outer bar buoy to Cockspur.

One of Savannah Main river, from Cockspur to Shad's Chimney.

Another of Savannah Front and Back rivers, from Shad's Chimney to Argyle Tree.

A chart of North Edisto bar and river.

Charts of Beaufort, North Carolina, bar and harbor.

Lieutenant Commanding Maffitt renders acknowledgments for the courtesy and facilities extended to him, while employed in Savannah river, by the officers of the army there stationed.

SECTION VI.—FROM THE ST. MARY'S RIVER TO ST. JOSEPH'S BAY, COAST OF FLORIDA, AND INCLUDING THE FLORIDA REEF AND KEYS.—(Sketch F.)

The work on this important and comparatively ill-known portion of our coast has been pushed vigorously, as far as the appropriation permitted, in all its branches. The land parties have had in use three vessels belonging to the coast survey, or hired for the purposes of transportation; and the hydrographic party the Coast Survey steamer Hetzel, which had been put in thorough repair after the accident of last year at Cape Canaveral. Four parties have thus been in the field, engaged on the main and secondary triangulations, the hydrography and

topography of those keys and reefs where the need of information was most urgent.

It should be remembered that the appropriation recommended by the Treasury Department in 1848-49 for the speedy survey of this section, was reduced from \$100,000 to \$30,000, and that the present limited scale of work merely provides for the ordinary rate of progress. Even as it is, however, the knowledge acquired and now ready for publication will be of no small value towards the saving of life and property, so often lost or perilled on this coast. The harbors of Key West and Cedar Keys, the passage of the Boca Grande, and many of the smaller keys and reefs, have been thoroughly examined and mapped; mistakes of charts in present use rectified; and determinations made for the sites of lights and buoys indispensable to the safety of navigation. Accompanying this report are—the general sketch F, showing the progress of work in this section; sketch F, No. 2, showing on a larger scale the progress of Cedar Keys, Dry Tortugas, Key West, Bahia Honda, and Key Biscayne; sketch F, No. 5, of the harbor of Key West and its approaches; sketch F, No. 4, of the harbor of Cedar Keys, with Suwannee bay to the northward and westward, and Wacassassa bay and the harbor and offing of Crystal river to the southward and eastward; and sketch F, No. 3, of Mosquito harbor.

The new channel at Key West, mentioned in my last annual report as indicated by the work for that season, has been found to afford a depth of 26 feet.

The depth that can be carried through the passage of Boca Grande is ascertained to be 13 feet. Into Cedar Keys bay it is found that, by the main channel under Sea-horse key, 12 feet can be brought in, and, perhaps, under favorable circumstances, 14.

Examination has confirmed the vaguely reported existence, off Crystal river and below Cedar Keys, of a harbor and anchorage (in the bay now called St. Martin's, just south of the Withlacoochee river) into which 12 feet, and, under favorable circumstances, 14 feet of water may be carried; and which will be valuable not only as a shipping port for the produce of several neighboring rivers, but as a place of refuge for coasting vessels.

It may be remarked, as a matter of general interest, that the survey indicates Way key as the most desirable and, indeed, the only suitable terminus for the railroad across the peninsula. The anchorage at Crystal river being at some distance from the main land, renders that point ineligible; besides, that the route would be over rivers and marshes to reach it.

Professor Agassiz has lent the aid of his distinguished talents in an examination, the results of which are embodied in a report discussing the topography of Florida, its reef, keys, coral reefs (living and dead,) ship-channel, main land, coast, and the physical changes in the Gulf Stream. Apart from the fact that this report would be too much extended by including that document, its importance requires that I should make it the subject of a special communication.

This examination was imperiously called for by the contradictory statements in regard to the character of the reef in its different portions, being by some represented as composed of living and growing coral—

by others of boulder masses of dead coral; sustaining, in the two cases, altogether a different relation to navigation, and to the questions of sites for light-houses and sea-marks. The very interesting question of the past growth of the Florida reefs and the formation of the present peninsula of Florida, and of the keys which form such remarkable appendages to it, has been fully solved by Professor Agassiz, who has also shown what may be expected in the future; and, establishing the fact that the existence of the coral depends upon the depth of the sea, proves that no reef is to be expected exterior to the one existing.

This, of course, supposes that no change occurs in the relative level of the land and water; and here, again, the labors of Professor Agassiz have been in the highest degree valuable, by establishing that no *general* change of this kind is going on in that part of the coast; the phenomena of growth of the reef, formation of the keys and of the main land, being explicable without such supposition. I have extracted such portions of the report of Professor Agassiz as bear most immediately upon the subjects of my present report, in the Appendix No. 10; but the whole work is too valuable to permit any portion to be lost, and I therefore respectfully recommend that it be presented to Congress by the department in a separate report.

Hourly observations of the tides near Key West have been made under my instructions, and the immediate direction of Lieutenant Commanding John Rodgers, United States navy. They have been plotted, and are in course of reduction and discussion, in the same manner as those at Cat island, Louisiana. The results are of great interest in reference to the general subject of tides in the Gulf of Mexico; but the investigation is, perhaps, in its present stage, too purely technical to make an extended notice desirable in this report. There are two high and two low tides daily at Key West; the successive tides being nearly equal about the time of the moon's passing the equator, and there being at other periods one smaller and one larger tide in the course of the twenty-four hours. This diurnal inequality is a very remarkable feature, and can already be approximately calculated.

The work of this section will be resumed as early as arrangements can be made for the ensuing season.

Reconnaissance, triangulation, &c.—Assistant F. H. Gerdes has been occupied (with the exception of a brief absence on duty in Section VIII) from November 1st, 1850, to June 20th, of this year—first, in reconnaissances, having for their object to select stations for the main triangulation, and to connect the Tortugas with the main body of the work; second, in preparing, clearing and grading a base line on Key Biscayne, and another at Cape Sable; third, in the establishment of stations, main and secondary, and in the triangulation.

The description of the coast and other information conveyed in Mr. Gerdes' report of a reconnaissance, which extended from Suwannee river to St. Martin's reef, are of so much interest that I annex the report nearly entire. (See Appendix, No. 31, and sketches F, Nos. 1 and 4.)

Mr. Gerdes has found that, by fixing a signal upon Rebecca shoal, about midway between the Tortugas and the Marquesas, the former group may be brought into connexion with the general scheme of main

triangulation. This plan involves less time and expense than those previously suggested, and dispenses with the use of reflecting instruments and of floating signals. A short base must be measured on the Tortugas, and an astronomical station for azimuth observations be made there. In that group, the triangulation from the Logger-Head base will furnish a proper side of nearly five miles, and a distance of four miles may be had at the Marquesas from the eastern triangulation.

The base lines, referred to in my last annual report, have been cleared with some labor, levelled, and well prepared for measurement. (See sketches F No. 3, and F No. 4, report of 1850.)

In the triangulation of this season 30 signals have been put up, and determined from 11 stations, forming 41 triangles, and embracing the whole of the harbor, with all four channels of the Cedar keys, and the islands themselves. A small preliminary base of about two miles was measured on Way key by chaining, and the ends, as well as all the stations of the triangulation, secured by posts. Six of the primary stations have been marked by stone monuments. The area covered by the triangulation exceeds 40 square miles; 96 angles were observed, usually by six repetitions direct and six reversed, sometimes by more frequent repetition.

Assistant Gerdes and party have also carried on their office-work—computation of results—during the season.

Secondary triangulation of keys and reef.—This part of the work was conducted by assistant J. E. Hilgard from December 20, 1850, to February 1, 1851, and from that time up to June 3d, (when the season was at an end,) by assistant L. F. Pourtales. The field of operations embraced Boca Chica, Key West, and the Marquesas, during the former portion of the season; and during the latter, Key Biscayne bay, including Soldier key, Ragged keys, Elliott's key, and Rubicon Point, with the main land from Shoal Point (twenty-five and a half miles, by the shoreline, southward from the mouth of the Miami river) to Turkey Point. (See sketches F No. 1 and F No. 2.) Mr. Hilgard gives the following statistics of his work: 9 stations occupied; 18 ditto observed upon; 100 angles, each the mean of six repetitions, observed (with the eight-inch Gambey theodolite, C. S. No. 24;) area of the work, 78 square miles. Mr. Pourtales reports 3 stations occupied; 18 points observed upon; 497 sets of measures of angles made; area of work, 70 square miles.

His comparatively small progress is accounted for by difficulties occasioned by the prevailing trade-winds, and by the uncertainty often arising from lateral refraction—the lines passing over shoal water, which rendered it necessary to repeat the observations frequently.

Much time has been occupied and great difficulties encountered, necessarily, in the erection of signals. Where it is necessary to insert them in the rock of the reefs the patent screw-pile of Mitchell has not yet been successfully applied; but it is hoped that, before the next season for observation, the object will have been accomplished by the addition of a heavy capstan-head applied to the screw-pile, and a tripod to steady it.

Should this apparatus not prove effective, the object may be attained, as suggested by Mr. Pourtales, by a modified application of an arrange-

ment already used by Major Bache, of the United States topographical engineers, consisting of an iron disk sunk into a bed, and having a socket in which to fasten a signal-pole.

Lieutenant James Totten, United States army, joined this party in the latter part of the season, with a view to qualify himself to take charge of its operations during the next.

Topography.—During the first five months of the current year, a party, under charge of assistant Hull Adams, assisted by Mr. R. M. Bache, was engaged in the survey of the keys and shore-line indicated in the accompanying sketch F, No. 2.

Sheet No. 4 contains Man key, Woman key, Mule key, Boca Grande, and the Marquesas.

This latter group embraces 9 distinct keys, has an area of 12 square miles, and a shore-line of 30 miles.

Sheet No. 5 contains Bahia Honda and seventeen smaller keys.

Sheet No. 6 contains Key Biscayne, Virginia key, and 25½ miles of the shore of the main land, from the mouth of Miami river southward to Shoal Point. It may be useful to mention two points on this shore where excellent fresh water can be procured: one, the "Punch Bowl," is about two miles, and the other, called "the Hunting Grounds," about twelve miles, below the mouth of Miami river.

The whole extent of shore-line included in the season's work is 139 miles, and the amount of area 186 square miles. Boca Grande, Woman key, and Virginia key, were surveyed by Mr. R. M. Bache.

The character of these keys is so little known that it may be well to quote the general description given by Mr. Adams:

"There is very little variety in the character of the topography of the keys surveyed during the past season. They are generally covered with a thick growth of mangrove, which extends quite to the water's edge. On the parts of the keys towards the reef, however, there is sometimes a good beach; but the entire inner side is of mangrove, with a very deep, thick mud along the edge. Upon the southern and eastern sides of the Marquesas there is a very good beach, which extends for about six miles, interrupted only by one inlet, of one hundred and fifty metres breadth. Key Biscayne has a fine wide beach on the eastern side, nearly four miles in length, of Atlantic sand, which is quite different from the shells and ground coral (Gulf sand) of the other keys. On the western side there is a very high growth of mangroves, and the character of the mud seems to be much the same as that about the other keys. This mangrove thicket extends nearly half across the island, for two-thirds of its entire length. The other part is covered with a thick palmetto scrub. The shore of the main land, commencing at Miami river, has a sort of hammock growth of about a quarter of a mile in width for three miles; after which, for about five miles, there is a prairie growth which extends back to the commencement of the pines. This pine land extends, in many places, to the everglades. For the next four miles the hammocks increase in width, interspersed with swamps and prairie grass. A narrow ledge of rocks, about ten feet in height and covered with trees, is a distinguishing feature of the first three or four miles below the mouth of the Miami river."

Hydrography.—The hydrographic operations were delayed by circum-

stances beyond my control, and were not commenced until January. Lieutenant John Rodgers, United States navy, assistant in the coast survey, has been in charge of the party, and commanding the Coast Survey steamer Hetzel, employed in the work.

The minute survey, now completed, of the harbor and approaches of Key West, has determined the valuable result, that safe passage for vessels of any class into that port may be permanently indicated. As remarked by Lieutenant Rodgers, the difficulties of approach for large vessels would at first appear insuperable. He points out positions in which a vessel may have three fathoms on one side, and six on the other—may run over a point with seventeen feet water on it, and have thirty-six feet by both leads. The profile view (sketch F, No. 5) is furnished by him to illustrate this extreme irregularity of the coral formation.

The drawing of the entire chart of Key West (see sketch F, No. 5) is furnished for publication, and its engraving has been commenced.

The general depth on the *spots* in the harbor varies from ten to twenty feet, and is, in their immediate vicinity, from twenty-five to thirty-six feet. Lieutenant Rodgers estimates that a safe channel for the largest ships may be marked out at an expense of about \$2,000, by *fixed* buoys, to be secured with heavy chains and Mitchell's mooring-screws; and observes that shifting buoys would be worse than useless—a snare. The value of this harbor is well urged by him, as follows:

“All the ocean-commerce of the valley of the Mississippi keeps within a few miles of Key West. The harbor is important as a place of refuge and repair, and this value grows with the commerce of the West.

“In time of war with a maritime power, its importance will be greatly enhanced, and its waters will be white with every class of sail, either seeking protection under its guns, or lying in wait for an enemy.”

The important passage of Boca Grande (from the Gulf of Florida into the Gulf of Mexico, used when the winds are light and the Gulf Stream current strong) has been surveyed, and the chart is nearly completed. It has been ascertained that thirteen feet can be carried over the bar.

A survey has been made of Mosquito harbor, which will be further mentioned in its proper connexion, (see sketch F, No. 3.) For a brief account of the inlet, its past condition, and recent changes, see Appendix No. 32, containing extracts from Lieutenant Commanding Rodgers' report. Soundings were attempted across the Gulf Stream, from Key West to Havana, but unfortunately arrested by the loss of the line; and in returning from Havana, the new method of sounding with twine could not be tried on account of bad weather. The experiments, however, were not without interest. Lieutenant Rodgers states: “We then ran thirty minutes S. S. W. by compass, or three miles from the last position, and in the same place (except drift) the following casts were taken:

370 fathoms,	no bottom,	white wax on end of lead untouched.
408	“	“
760	“	“
2,977	“	“ (apparently.)

"In reeling up, the line parted 245 fathoms from the surface of the water.

"At 2,977 fathoms, I thought that the lead had not reached bottom, because I could perceive no abatement in the velocity of the line running through Burt's patent sounding nipper. Whether the lead did reach bottom at that depth would have been shown by the wax arming upon regaining the lead; unfortunately it was not regained.

"After leaving Sand key, the vessel was, by astronomical observations, first set to the westward of her course, and afterwards to the eastward of it. The lead-line seemed not to partake of this drift, since the vessel was first set to the westward of the line; and to the eastward of it when the current farther from the shore had become easterly. These facts lead me to the inference (which the difference of the temperature shown between the surface water and the deep-sea soundings may seem to corroborate) that the current does not run at such great depths as the lead reached."

For the season, from January 4 to June 17, 1851, the work of the steamer and boats amounted to 2,492 miles of soundings, for which there were 95,332 casts made of the lead, and 4,120 angles measured for position.

Pending the delay in the arrival of the vessel assigned to Professor Agassiz for transportation, Lieutenant Commanding Rodgers afforded his aid and the use of the steamer Hetzel, for the exploration (before mentioned) conducted by that gentleman.

Light-houses, buoys, &c.—Assistant Gerdes' examination (Appendix No. 31) has confirmed the suggestion of Lieutenant Commanding James Alden, United States navy, reported last year, that Sea-horse key is the only suitable site for a light-house, which was appropriated for by the last Congress, to be placed somewhere in the approach of Cedar Keys. It should be placed at a sufficient elevation (for which a spot elevated 45½ feet is designated by Mr. Gerdes) to show over the whole Sea-horse reef. That reef has been found to extend in reality about fifteen miles, although its length has hitherto been laid down on the charts as about seven.

Mr. Gerdes adds: "There ought to be a buoy placed on the point of this reef, by all means. In foggy weather the Sea-horse (key) is invisible from thence, and the reef is very difficult to distinguish, as the water outside deepens only gradually, and retains the same color. A screw-pile, (disk-screw,) with a barrel, could be inserted easily, the reef being only of quicksand, and a sort of coral sand."

Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, has surveyed the Mosquito inlet with reference to the placing of buoys. For his report see Appendix No. 33, and sketch F, No. 3. In the same report he discusses the subject of communication between the local pilot and the vessel, in weather when boats cannot cross the bar. Local conventional systems of signals have been adopted for this purpose in some places, but it is highly desirable that a uniform method should be adopted by authority, for all the barred harbors of the United States; such a plan forms part of his report, and it is respectfully commended for consideration, (see Appendix No. 33.)

Assistant Gerdes recommends very strongly—and his recommendation

is concurred in by Lieutenant Commanding Rodgers—that a lighted beacon or a light-house be placed on Rebecca shoal, between the Marquesas and Tortugas. The passage in which this shoal or reef lies is a thoroughfare for vessels bound to ports in the Gulf of Mexico; the shoals are therefore dangerous, and at present are not marked. For the letters of Lieutenant Commanding Rodgers and Mr. Gerdes on this subject, see Appendix No. 34.

SECTION VIII.—FROM MOBILE POINT TO VERMILION BAY, INCLUDING THE COAST OF ALABAMA, MISSISSIPPI, AND PART OF LOUISIANA.—(Sketch H.)

The operations of this section have been on the same general scale as hitherto, the greater proportion of the means being, however, devoted to the hydrography, which is proportionably less advanced than the other parts of the work. One secondary triangulation party and one topographical party have been employed in extending the work westward, over Mississippi sound and Lake Borgne; and a hydrographic party, having an efficient steam-vessel (the Coast Survey steamer Walker) and other facilities, have been occupied in off-shore work south of Dauphin and Petit Bois islands, and in-shore work north of the same islands, and in special examinations of Pass Christian harbor and the mouths of the Mississippi.

The secondary triangulation of the previous year was necessarily in part repeated, and a new connexion made with the primary work; which, with the character of the season, has rendered the progress less than was expected. The triangulation of the Bay of Biloxi and of St. Louis bay was completed. The topography has well advanced to include both sides of Pass Christian.

A steam-launch, constructed by Mr. J. G. Young, engineer United States navy, under the immediate direction of Lieutenant Commanding Jas. Alden, for in-shore and harbor work in this section, was unfortunately lost in a storm off the Chandeleur islands in May, so that the party had but little aid from her services.

The discussion of the tidal observations at Cat island has been continued under my immediate direction, and the results deduced have been found of considerable interest in a practical and scientific point of view. Persons who had longest observed these tides believed that they were without regularity, and navigators generally who had attended to them, supposed that they resulted from the action of the wind. I have shown, on the contrary, that the results are strictly referable to law, and do not depend upon the wind, except as a modifying cause. The first results deduced are given in a paper presented, by authority of the Treasury Department, to the American Association for the Advancement of Science, at their meeting in August, 1850, which, with some revision, is transferred to the Appendix No. 7. It is not a little curious that a case of the single-day tides, to which these belong, (having, as a general rule, but one high and one low water in the twenty-four hours) should be among the earliest on record, having been examined by Newton in his original discussion of the tides in connexion with the theory of gravitation. The phenomenon met no further development until recently

observed in the tides of the eastern coast of Asia, and in the higher regions of the northwest coast of America, by the Rev. W. Whewell, who was the first successfully to trace its laws from observation. The small rise and fall of the water in the Gulf of Mexico, renders exact and continual observations necessary to ascertain the facts. Such observations have now been obtained at the two localities of Cat island and Fort Morgan, and will be followed, in due course, by observations at a sufficient number of points to trace the tides of the Gulf. (See sketch H, Nos. 2 to 6.)

A more considerable portion of the means available for this section than in preceding years has necessarily been devoted during the past year, and must be applied in succeeding ones, to the preparation of the results for publication. The computations have been kept up; the reduced drawings of Mobile bay (two sheets) have been in progress; the engraving of the entrance sheet of Mobile bay has been completed and published, and that of one of the sheets of the inner bay has been commenced. The lower sheet of the bay will form part of the general coast sheet, extending over Mississippi sound, westward.

At the request of parties interested, an examination was commenced of Milneburg harbor, on Lake Pontchartrain, the terminus of the railroad from New Orleans. Assistant S. A. Gilbert, after closing his triangulation in this section, visited the spot, and has furnished the data requisite for undertaking its hydrography; but, owing to unavoidable circumstances, this information was not received by the officer in charge of the hydrographic operations, until too late for him to begin the survey that season. Lieutenant Commanding Sands, United States navy, is under instructions to execute it during the ensuing season.

Sketches of the reconnaissance of Pass Christian harbor, and of the mouths of the Mississippi, (Pass à l'Outre and the Northeast and Southeast Passes.) accompany this report.

The first-named examination was made at the request of the citizens interested in Pass Christian. That town occupies a somewhat important relation to New Orleans as a healthy summer residence for families; and it is represented that intercourse is rendered difficult, and the mails delayed, by frequent grounding of the steamers upon the shoals. (See sketch H, No. 9.)

By the reconnaissance of the Mississippi delta, (sketch H, No. 8,) an interesting comparison is furnished with the survey made by Captain Andrew Talcott, corps of engineers United States army, in 1839, showing that the marshes have generally been extending further out to seaward; that the channel has deepened at the Pass à l'Outre, and become shoaler at the Northeast and Southeast Passes.

The judicious recommendations of Lieutenant C. P. Patterson, United States navy, in regard to beacons and buoys upon this coast, which he had made a matter of special study, and in respect to which his views were seconded by his successor, still remain unacted upon, as at the date of my last annual report. To what is already contained in that report I can add nothing but a respectfully renewed invitation of attention to the subject. Should the scheme there suggested appear of too much magnitude to be embraced in the appropriations of a single year, it may at least be commenced, and gradually and systematically carried

out to completion, so that partial benefits shall be realized in proportion to its progress. The commerce of Mobile bay, and of the harbors of Cat and Ship islands, has great need of such facilities for navigation. (See Appendix, Nos. 35 and 36.)

For the determination of differences of longitude by methods described in my last annual report, I have had in view the establishment of a station for telegraphic connexion between New Orleans and Washington, by the line of the coast or by a line passing through Cincinnati and the valley of the Mississippi. Assistant Gilbert recommends Fort Wood or Fort Pike as suitable and convenient points for the purpose of connecting with the coast line of telegraph, being included in the scheme of triangulation, and within a few hundred yards of the telegraphic wires from New Orleans to Mobile.

Triangulation, (sketch H.)—This portion of the work was under charge of assistant Samuel A. Gilbert, who was supplied with a small vessel for transportation, and was aided, during the latter part of the season, by Mr. Charles M. Bache. The party was engaged for five months, ending May 20th—first, in the triangulation of Biloxi bay; second, in connecting that series with the main scheme to the eastward; third, in the repetition of observations of the previous year in St. Louis bay, unsatisfactory through defect of the instrument; and finally, in the extension of the secondary triangulation westward over Mississippi sound and Lake Borgne to the eastern shores of Lake Pontchartrain. Mr. Gilbert's summary of results is as follows:

"The area covered by the triangulation of Biloxi bay is 48 square miles. The area covered by the work necessary to the connexion with the main series, and previously covered by it, is 40 square miles. The area covered by the triangles remeasured is 96 square miles—being in all 184 square miles.

"The area covered by the triangulation as yet unobserved, but of which all the signals have been erected, is 608 square miles. The number of angles measured is 67, for the determination of which 94 series of 12 repetitions each, and 8 of 6 repetitions each, or 1,176 angles, were observed."

The experience of the party indicates the months of May and June as more favorable for observing, in this region, than the three months preceding.

Assistant F. H. Gerdes made a brief visit to this section, which was employed in erecting permanent marks at the main stations.

Topography, (sketch H.)—Assistant W. E. Greenwell was engaged in this duty, aided by Mr. W. M. Johnson, and having the use of the Coast Survey schooner Phoenix. The resulting work is indicated by the accompanying sketch, which embraces (in three sheets, marked 18, 19, and 17, respectively) Pass Christian and its vicinity, the Bay of Biloxi, and coast eastward as far as West Pascagoula river. Upon the general topography of these sections, Mr. Greenwell's remarks may be quoted as interesting:

"The character of the country embraced in sheet No. 17, or the one running from West Pascagoula river to Biloxi bay, is similar in every respect to that described in previous reports—the shores being low and smooth, thickly wooded to the very water with pine, principally, inter-

spersed with magnolia and hammocks of live-oak. Skirting the shore along is here and there a settlement, with small spots of cultivated ground, whilst the interior, for miles and miles back, is but a dense forest of pine, apparently in its wild and primitive state.

"The character of the topography upon sheet No. 18 is very similar to the one just described. The town of Pass Christian, situated upon a ridge of fast land, about twenty feet above high water, sloping gradually towards the sound and again back in the interior, presents the only feature different from sheet 17. Around it is the same wild, thick forest of pine as seen along the whole coast.

"The features of the country embraced in the Biloxi sheet are somewhat different from that just described. On the east shore of Biloxi bay the banks are abrupt, being from twenty-five to thirty feet in height, and of a red clayish soil. Here, too, unlike the other parts of the coast, the shores are quite thickly settled, and improvements have been made, and are still making, which, in a few years, will make it a place of some importance.

"Along the shores of the 'Back bay,' and on the banks of the bayous emptying into it, are at present, in successful operation, many mills, foundries, &c. From these and other resources a trade between Biloxi and New Orleans is kept up, amounting to about \$390,000 per annum, keeping in constant employment about eighty or ninety vessels, amounting in all to about three thousand five hundred tons."

During the season of five months (December to June) the area surveyed was 65 square miles; the length of shore-line 227, of roads 27, and of streets and wharves 15 miles.

Hydrography, (sketch H, Nos. 7 to 10.)—The party under charge of Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, was engaged in the survey of Bon Secours bay until its completion, when that officer was transferred to another section. The operations were conducted during the remainder and greater portion of the season by Lieutenant Commanding B. F. Sands, United States navy, assistant in the coast survey. The steamer Walker was appropriated for the use of this party.

The work off the entrance of Mobile bay was extended off-shore, both eastward and westward, (south of Dauphin and Petit Bois islands,) to the distance of eight or ten miles. Pass Christian, in Mississippi sound, was, in compliance with a special request of the residents, closely sounded from Henderson's Point to near Pitcher Point, and three and a half miles from shore. It is thus described by Lieutenant Commanding Sands:

"A depth of seven feet can be brought into the channel from the west by keeping the west beacons open to the southward, passing to the southward of the first beacon and northward of the second. At the eastern beacons it is rather shoaler; 6.3 feet can be taken in, with the inner beacon open to the eastward of the new church steeple until nearly up with that beacon, and thence to the steamboat wharf. The bottom being soft and the current strong, I should suppose a mud-machine could, at comparatively little expense, deepen the channel at the east and west beacons sufficiently for steamboat navigation."

A reconnaissance was also made, by the same officer, of the Missis-

issippi delta, to which I have already referred as showing considerable change. "The marshes have made out seaward, mud-lumps have been washed away, and others formed." From his report I quote the following useful advice for entering the Mississippi river:

"On account of the frequent changes on the bars, no sure sailing-directions can be given for crossing at any of the passes. Vessels should not approach the shore nearer than the depth of ten fathoms without a pilot, as it shoals up from that depth rapidly; and at night, after seeing the light at Northeast Pass, they should heave to or anchor outside of ten fathoms until daylight, when the pilots and tow-boats come out.

"The tow-boats generally anchor inside of the entrance, and in fair weather cruise off from ten to fifteen miles. Vessels are rarely delayed for want of tow-boats, as there is considerable competition, and they keep a good lookout for the offing."

The progress effected this season is shown in sketch H, of which the sheet marked No. 11 indicates the work of Lieutenant Commanding Alden, the remaining sheets that of Lieutenant Commanding Sands—the former embracing 95 square miles of area, 223 miles of soundings, and 13,760 casts of the lead; the latter, 275 square miles of area, 688 miles of soundings, and 28,244 casts of the lead. The time employed was from January 16 to June 10, 1851.

From the results furnished by the hydrographic surveys, sailing-directions for Horn Island pass were made out and communicated to parties interested. (See Appendix, No. 37, and sketch H, No. 7.)

SECTION IX.—FROM VERMILION BAY TO THE BOUNDARY, INCLUDING THE COAST OF PART OF LOUISIANA AND TEXAS.—(Sketch I.)

The work in this section has been conducted on the scale of previous years, three parties being in the field. Its progress is represented on the general sketch I. The triangulation has been carried from the vicinity of Galveston as far westward as the Brazos river, and all the primary and secondary station-points secured by permanent marks. An attempt to extend the secondary work into East bay failed, from insufficient depth of water, no means of land transportation being accessible. The topography of the bays about Galveston has been completed, as also the hydrography of the harbor, entrance, and approaches. The chart of Galveston entrance is in course of reduction for publication, and its engraving is provided for. A hydrographic reconnaissance and delineation of Aransas Pass and minute examinations of sites for light-houses in Galveston bay will be reported under their proper head. The rapid and extensive changes of the Aransas bar will appear worthy of special notice.

Peculiar difficulties are opposed to the work by the climate and topography of this region, which disturb the atmosphere so as to destroy its transparency; and which have induced the recommendation by assistant Williams of a diminished length of sides for the triangles. The obstacle of the belts of timber on and about the Brazos, which proved somewhat in the way of the triangulation, is supposed to be the only feature of the kind on the coast of Texas, from the Sabine to the Rio Grande.

Hourly observations of tides have been instituted, and will be kept up by observers stationed at Galveston. These tides are observed and discussed on the same plan as those of Cat island and Mobile bay, in 1848 and 1850-51, and as at present at Key West—forming part of a system for ascertaining the tidal phenomena of the Gulf of Mexico.

Triangulation, (see sketch I.) Assistant James S. Williams has been in charge of this portion of the work, aided by sub-assistant Spencer C. McCorkle, who was for the most part separately engaged in reconnaissance and observations for the secondary and tertiary triangulation. The Coast Survey schooner Belle was in the service of the party.

The main triangulation has been connected, from the newly occupied primary stations, Chocolate and Hall's bayou, with that of the previous season. In extending the scheme westward from the new station Peninsula, assistant Williams was encountered by the serious, and, on this coast, exceptional obstacle, of heavy belts of timber on the Brazos river, Oyster creek, and Bastrop bayou. He has, however, so selected the points Jupiter and Hamilton, that the line from the Peninsula to the former, although striking the villages of Velasco and Quintana, passes along a street, and the lines from Hamilton to the other two points pass through openings in the timber.

In observing over the long lines of sight of the main triangles, great obstacles are encountered, which Mr. Williams thus enumerates: "The climate of this region, unless the last season is an exception to its general character, is singularly unfavorable for extended geodetic operations. The stormy winter, the short twilight, and intense heat of cloudless summer; the frequent, almost constant, high winds; the hazy, misty air,—all battle against progress; indeed, the air may be said to be clear only during a norther, when it is impossible to make an instrument steady on its high tripod."

In one case, twenty-three days were occupied in endeavoring to effect measurements that in a favorable atmosphere would have required but a few hours. Mr. Williams recommends contracting the sides of the main triangles, that more results may be obtained in proportion to the time.

The secondary and tertiary triangulation has substantially advanced as far as the Brazos river. The contraction of the side between Oyster creek and Rattlesnake secondary stations, somewhat marring the symmetry of the general scheme, was a judicious measure of economy to avoid cutting through heavy timber. Some time was lost in an unsuccessful attempt, before mentioned, to extend the work into East bay, in the other direction.

In reference to the preservation of stations, assistant Williams reports: "The primary points that have been occupied during the season are each marked by an earthenware cone, buried three and a half feet below the surface; upon this a wooden piece, one foot square, rests, and supports a granite block, two feet long and ten inches square, marked with a cross upon its middle point. Besides this, three smaller granite blocks are sunk to within three inches of their upper surface—north, south, and east from the centre, and three feet distant. The secondary

points are marked by the cone in the centre, and the three blocks disposed, as above, around it."

In this season, from December 10, 1850, to June 10, 1851, 8 stations have been occupied, of which 3 were primary, and 5 secondary; 58 angles measured from 2,484 observations; 15 signals have been put up, giving 163 square miles in area of primary, and 99 square miles of secondary triangles. The instrument used by assistant Williams was C. S. theodolite No. 31.

Assistant Williams, in his report of a reconnaissance for triangulation, remarks upon the unusual topography of a portion of the coast, as follows: "I have found along the Brazos river and Oyster creek (which run nearly parallel for twenty miles from the Gulf) belts of heavy timber, principally live-oak, coming down to within five miles of the gulf, and varying in breadth from one to three miles. Crossing Oyster creek at a point about fifteen miles from the gulf, and proceeding eastward, I found heavy live-oak timber on the head of Bastrop bayou."

Topography.—The party of sub-assistant J. M. Wampler was in the field during the first five months of 1851, and had in use the Coast Survey schooner Nymph. Its duties were made arduous by an inclement season, and by the necessity of often working at stations covered with water.

The results of the work are comprised in a complete topographical map of Galveston bay, (see sketch I, No. 2,) of which about one-third had been accomplished the previous season. The amount of work may be reckoned as follows: shore-line surveyed, 281 miles; area of country, $188\frac{1}{2}$ square miles; and 25 miles of roads. It includes West bay, East bay, and Bolivar peninsula, Turtle bay, and the delta of Trinity river.

Hydrography.—Lieutenant Commanding T. A. Craven, United States navy, assistant in the coast survey, was in charge of the party, and of the Coast Survey schooner Morris, engaged in this work. He has made a survey (see sketch I, No. 2) of Galveston harbor and its approaches. Sheet No. 1 comprises the harbor, and sheet No. 2 the bar and approaches.

During the season, from March 19 to June 29, the lines of soundings amounted to 484 miles; the number of soundings being 31,100, and the area surveyed 55 square miles. The soundings were made in depths of from one foot to eight fathoms. 1,665 observations of angles were made.

The depth of water on Galveston bar is stated to be twelve feet.

Lieutenant Commanding Craven has also made a special examination of Clopper's bar, Red Fish bar, and Half Moon shoal, in Galveston bay; and of Aransas Pass, the entrance used for Corpus Christi as well as Aransas bay. All of these (see sketches I No. 2, and I No. 3) will be referred to in their proper connexion. I may quote here, however, Lieutenant Craven's mention of the remarkable changes about Aransas Pass, (sketch I, No. 3,) as follows:

"The point in my reconnaissance designated as '*Old Range*,' was, in 1846, *within 120 yards of the channel*, and the '*Range*' itself was *awash*. It is now 350 metres from the beach, and upwards of half a

mile from the mid-channel. The 'capstan' was planted in 1849, for heaving off a vessel which had grounded in this channel.

"The point I have marked as '*E. Range*' was formerly a Pilot's Range, and fifteen months since was about fifty yards from the beach in the channel way; it is now 340 metres from the beach.

"You will see from the above, that the point of St. Joseph has, for five years, been working rapidly out to the southward, and as it encroaches on the channel, the opposite point of Mustang island wears away with equal rapidity. All of the point of St. Joseph, from the '*Old Range*' to the spit at the Narrows, is a loose, sandy flat, which has been entirely formed since 1846, and on which vegetation has commenced. I found an unusual depth of water on the bar, nine and a half to ten feet, which may be accounted for by the strong and continued southeast winds of this season; ordinarily there are from seven to eight feet."

A temporary tidal station was established in connexion with the soundings about Galveston, and observations made additional to those at the regular station, which has been left in charge of an observer. The latter station was transferred from Bolivar Point, for greater convenience, to the city of Galveston.

Light-houses, buoys, &c.—Appropriations were made at the recent session of Congress for light-houses in Galveston bay, and preliminary surveys have been required for their location.

My report upon the subject, and that of Lieutenant Commanding Craven, who surveyed the sites proposed, will be found in Appendix No. 38.

I have recommended the erection of three light-houses, namely: on Clopper's bar, Red Fish bar, and Half Moon shoal—the two latter conditional upon the approval of some competent engineer, doubts being expressed by Lieutenant Commanding Craven as to the stability of the foundation. (See sketch I, No. 2, and sub-sketches.) That officer suggests, also, the necessity of a buoy off Dollar Point.

The reconnaissance of Aransas Pass indicates such frequent and rapid shifting of the bar and beach, that no light-house can be suitably placed with a prospect of permanence. The report of Lieutenant Commanding Craven (Appendix No. 39, and sketch I, No. 3,) giving details of the harbor and its changes, recommends a small light-vessel and buoys on the bar. In the same connexion, objections are strongly urged against the present location of the light-vessel at Galveston.

SECTIONS X AND XI.—THE COAST OF CALIFORNIA AND OREGON.— (Sketch I.)

In my last annual report, showing the progress of the work in California and Oregon up to October, 1850, the future course proposed for the survey of the western coast was stated as follows: "To determine the geographical positions of the prominent points, correcting existing charts by them and by intermediate reconnaissances, and using them as points in the final survey; to make such surveys of harbors and anchorages, of sounds, of bays, and of portions of the coast, as may be most immediately useful, taking up first the parts necessary for the

establishment of light-houses, beacons, buoys, and other aids to navigation, using the methods of the Coast Survey, and establishing such permanent marks as will enable us to bring together these detached parts into a complete survey of the coast; to publish the successive approximations which we make, so that, whenever we have better materials than those already existing for charts, they may be given to the navigator, without waiting for the best results which we can produce. In this spirit, the reconnaissance of the coast now preparing for publication will be followed by a similar one south from Monterey; the sites for the light-houses provided for in California, now under examination, will be reported upon; the preliminary survey of Columbia river entrance, now reducing, will be published, and the examination carried up the river to Fort Vancouver, and up the Willamette; the portions of San Francisco bay, the surveys of which are required by the Engineer department and for light-house purposes, will be first taken up, to be followed by a complete survey of that and of the adjacent bays, after less known portions of the coast have been embraced in the work."

In accordance with the principles thus laid down the survey has been prosecuted, upon a scale increasing as new appropriations became available, and with all the energy to be expected from the meritorious officers engaged in it. Although it was late in this season before the operations could be disembarrassed of difficulties growing out of the want of funds and the peculiar circumstances of the country, yet the beneficial effects of a more liberal expenditure are beginning to be realized; and I feel justified in pointing to the results, as a worthy and valuable contribution towards the knowledge of our Pacific coast and the safety of its navigation. If those results are not fully equal to our expectation, they have fallen short only through causes defying the control of man—I allude to the lamented death of him from whom we had received most, and from whom we hoped so much more; the wreck and necessary abandonment (on the coast of Patagonia) of our steamer; and the serious injury and detention of our sailing vessel south of San Francisco—disasters which have combined to leave our hydrography, especially, behind our hopes and just anticipations.

Before proceeding to an account of the work, I feel that a pause is due to honor the memory of him who was its able and ardent pioneer, and whose name must hereafter be identified with the western coast as its most distinguished and useful explorer—Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey.

The tribute paid by his associates to his memory seems to deserve a place in the records of the government and the work which he so faithfully served and honored; it is accordingly annexed in Appendix No. 40.

I proceed to present the state of the work. It will be remembered that, up to the date of my last annual report, our operations had furnished: 1st, a general sketch of the coast from Monterey to the Columbia river, with hydrographic notices, including detailed descriptions of principal entrances, and with a table of approximate longitudes and latitudes; 2d, a preliminary survey of the Columbia river, from its entrance to a point above Astoria; 3d, a survey of Mare Island straits, in the bay of San Pablo, interior to that of San Francisco; and 4th, reports

upon light-houses for the bay of San Francisco, for Cape Disappointment, at the entrance of the Columbia river, and for New Dungenness and Cape Flattery, in Oregon.

Since then, the leading objects in our plan of operations have been the exact determination of the position of prominent points, and the surveys necessary for the establishment of lights and channel-marks most important to the present wants of navigation. The astronomical and topographical parties, and, as far as practicable, those engaged in triangulation and hydrography, have combined upon the same localities to effect the rapid completion of the purposes in view; and the two former parties have been for the most part left together, for convenience of co-operation and economy of transportation. The triangulation party has united with its normal scheme not only the surveys requisite for the location of light-houses, but those of a general character called for by the joint commission intrusted with the selection of sites for military and naval establishments. The hydrographic party, crippled in its operations by causes already cited, and which will be more fully dwelt upon, has lent its aid to the others, and of late has been occupied in important independent examinations; among which the continuance of the general reconnaissance to the southward of Monterey ranks first, and will be pushed as rapidly as practicable. I proceed to state briefly, reserving details for their proper place, the general results of the season, which are:

1. The exact determination (for which see Appendix No. 41 *bis*) of Point Conception, the Hatteras of the western coast, and its survey for the location of a light-house. The latitude was computed from astronomical observations made at that point; the longitude, from the comparison of observations there of moon culminations with others made on the Atlantic coast. The magnetic variation was also determined. The topography exhibits the proper site for the light-house authorized by Congress, and embraces several miles of the neighboring shore.

2. Similar observations to fix the geographical position of Point Pinos, at the entrance of Monterey; and a similar survey, indicating the best situation for a light-house. (See Appendix No 42.)

3. The astronomical observations made for determination of Punta Loma, in the bay of San Diego. The triangulation and topography of that bay, covering all that portion of it available for commerce; and so much of the hydrography as is necessary for the entrance, and with reference to location of a light-house. Also sailing directions for approach and entrance of the harbor; and a light-house report. (See Appendix No. 43.)

The topography embraces all that will be needed, after completion of the hydrography, for a harbor chart.

The triangulation extends from the False bay, on the north, to the Mexican line, on the south—thus connecting the coast survey work with the “initial point” of the boundary survey, established by Major Emory, United States topographical engineers. A sketch of the islands called “Los Coronados” has also been furnished, giving their approximate position.

4. Observations at the entrance of Columbia river for the position of Cape Disappointment, with a topographical survey of the cape, and a

report for the location of a light-house, by law provided for, on that point. (See Appendix No. 44.)

The fogs prevalent upon this coast interpose a serious obstacle to observations for latitude, and to those for moon culminations; but the ordinary transit observations for time are more easily attained; and, to make these available, a chronometer expedition, between San Francisco and the mouth of Columbia river, has been organized, and is in progress, for the determination of longitude. Its results are not yet reported.

The topographical party has also extended its labors over Point Adams, on the opposite shore of the Columbia and its vicinity; and the hydrographical party has furnished views (eye-sketches) of the entrance and approaches of Columbia river, representing the features of the coast. Ten iron can-buoys were shipped in January, 1851, and the remaining two in February, to be delivered to the collector of customs at Astoria, Oregon. They have been received, and are to be placed under the direction of the coast survey party in the vicinity.

5. Preliminary surveys of Humboldt Harbor and Trinidad bay, the former believed to be, in point of excellence, the *third* harbor on that coast, easy of access, and having twenty-one feet on the bar at low water; the latter is reported as affording a good harbor of refuge, and, during half the year, a safe and convenient anchorage. A site for a light-house, provided for by law, to be placed at the first of these bays, has been examined and reported upon. (See Appendix Nos. 57 and 57 *bis*.)

6. Surveys in and about the bay of San Francisco, by combined triangulation and topographical parties, preliminary to the general triangulation, and yet immediately directed to light-house and defensive purposes. These embrace:

A minute survey of Fort Point, at the entrance, and Alcatraz island, inside the bay; proposed sites for light-houses, (see Appendix No. 46.) The survey of the southern shore of the bay, founded on a measured base, and covering the ground pointed out by the joint commission for examination with reference to fortification. A reconnaissance of the Farallones (islands) for rectification of their position. A survey of Mare island, united with that of Mare island straits, and extended over the Straits of Carquines. This survey furnishes all the topography needed for the information of the joint commission, with a view to the location at Mare island of a navy yard. Approximate determinations of latitude and longitude have been made on the southern shore of the bay.

The more exact geodetic and hydrographic operations of the survey have been deferred in this harbor, (though their application at an early period is contemplated,) not through an under-estimate of its ultimate importance, but because existing charts yield better approximate knowledge of this than of other principal portions of the coast. It has therefore been estimated that the same amount of labor would yield greater and more immediately beneficial results even to the commerce of San Francisco itself, if dispersed through other fields, than if concentrated there. The charts of Captain Beechy, British navy, those of Captain Wilkes, of the United States Exploring Expedition, and, more recently,

those published by Captain Ringgold, United States navy, leave far less to be desired for this than for other leading points.

7. To the above general account of operations it is to be added that the hydrographic operations have recently been directed to some revision of the general coast reconnaissance between San Francisco and Monterey; the extension of that reconnaissance from Monterey southward has been entered upon; and the survey of the bay of Monterey has been already executed.

Having received, during the last year, two interesting reports from Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey, referring respectively to the general character of the coast of California and to the commerce of Columbia river, I have embodied those reports in the Appendix, (Nos. 48 and 49.)

Astronomical and magnetic observations.—Assistant George Davidson is in charge of these. At the date of my last annual report he was engaged at Point Conception, by far the most dangerous, and therefore the most important point, in reference to coast navigation. His observations were for latitude, for longitude by the method of moon culminations, and for magnetic variation and dip. The results have been computed and published.

From that point (after unavoidable delays arising from untoward circumstances, especially the injury of the schooner Ewing in a gale, which compelled the return of the party to San Francisco) assistant Davidson proceeded to establish an observatory near Monterey, in connexion with the survey for a light-house site—from thence to San Diego, and finally to Cape Disappointment, mouth of Columbia river; pursuing the same system of observations at each as at Point Conception. The last advices left him at Cape Disappointment, whence he proposed to pass successively to the determination of Capes Orford and Mendocino, the two most prominent points between the Columbia river and San Francisco.

As soon as the advance of winter renders it necessary to leave the field in Oregon, assistant Davidson proposes to establish stations at points along the coast, and determine their differences of longitude by transit observations, in connexion with transportation of chronometers. The success of this scheme would add San Pedro, Santa Barbara, Trinidad and Humboldt bays to our list of points exactly determined.

Assistant Davidson is aided by Mr. John Rockwell.

Triangulation, &c., (sketch I, No. 9.)—Assistant R. D. Cutts was assigned to this section to take charge of a double party for combined purposes of triangulation and topography. The circumstances of the work pointed to his selection as peculiarly fitted for the superintendence of mixed operations, versed as he is by experience in every branch of the duties of the coast survey. His operations were specially directed to the examinations requisite for light-houses, and to those asked for by the joint commission on military and naval establishments, (for correspondence in relation to which, see Appendix No. 3, in my report of 1850.) The general surveys for the purpose last mentioned have been accomplished. The results for the season have furnished—

1st. The survey of Alcatraz island and Fort Point, and a report on them as sites for light-houses. (Sketch I, No. 6, and Appendix No. 46.)

2d. The topography of the southern shore (including the island of Yerba Buena) of the bay of San Francisco, from the vicinity of the city to that of Point Lobos at the entrance—including the contemplated sites for fortifications—founded on a base measured on the beach of San José. (Sketch I, Nos. 6 and 9.)

3d. An examination of the Farallones for approximate determination and rectification of their position, (Sketch I, No. 6,) and Sailing Directions, (Appendix No. 47.)

4th. A survey of Mare island, its straits, the entrance and part of the Straits of Carquines, affording all the topography necessary for proposed establishment of a navy yard at Mare island. (Sketch I, No. 2.)

5th. Topography of the northern shore of the bay of San Francisco, (sketch I, Nos. 6 and 9,) from Saucelito to Point Boneta.

6th. The triangulation (for which a preliminary base was measured) of the bay of San Diego, from False bay to the Mexican territory. "The southernmost signal is on the boundary line, and about forty feet westward of the marble monument marking the initial point." Combined with the topography of sub-assistant Harrison, this furnishes a map of the bay, for which see sketch I, No. 7.

Augustus S. Rodgers, esq., was the aid of assistant Cutts, and was specially employed on the topography.

The statistics of the season's work show: 2 preliminary bases measured, 68 signals erected, 37 stations occupied, 170 angles determined by 4,688 observations, 4 stations whose altitudes were determined by spirit-level, 20 stations whose altitudes were trigonometrically determined, 228 vertical angles measured, and 188 observations for azimuth.

Topography.—Sub-assistant A. M. Harrison was at the head of the topographical party longest in the field. For brevity's sake, I refrain from a recapitulation of his movements, which have been so far identical with those of the astronomical party, except that, at the last advices, he had passed to the topography of Point Adams, and the southern shore of Columbia river. Mr. Harrison's operations, as already stated, have been mainly directed to the surveys necessary for location of light-houses. His results are embodied in—first, a sketch of Point Conception and its vicinity, for several miles of shore-line, and a light-house report, (see sketch I, No. 3, and my report, Appendix No. 41;) second, a sketch of Point Pinos and shore-line of vicinity for several miles, and a light-house report for the entrance to Monterey, (see sketch I, No. 4, and Appendix No. 42;) third, a topographical map (sketch I, No. 7) of the bay of San Diego, including Punta Loma, proposed as the site for a light-house, and La Playa, the port of San Diego, accompanied by a report descriptive of the bay, (Appendix No. 50,) and a report upon the location of a light-house, (Appendix No. 43;) fourth, the topography of Cape Disappointment, and three miles of the shore at the entrance of Columbia river, (sketch I, No. 10,) and a report in reference to the erection of a light-house at that point, (Appendix No. 44,) also the topography of Point Adams the opposite cape.

For local information and description, I refer to these reports.

The topographical operations of the party under assistant Cutts are so bound up in execution, and in results, with those of the triangula-

tion, that, to avoid tedious repetition, I have described them under that head.

Hydrography.—Up to the date of my last annual report, the late Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey, was in charge, but survived a short time only. He was succeeded, December, 1850, in the command of the Coast Survey schooner Ewing, by acting master J. H. Moore, United States navy, who was relieved, May, 1851, by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey. During this period, the Ewing was severely injured in a gale, and for some time under repair.

Lieutenant Commanding Alden, delayed by the difficulty of shipping hands at the then prices of California, which far transcend all Atlantic ideas, set out, about the middle of June, for a preliminary survey, which occupied about two months, of Humboldt and Trinidad bays. For his maps, see sketch I, Nos. 8 and 5. His general description of the character of those bays, I quote as follows:

“Trinidad bay is a very convenient and safe anchorage during six months in the year, and will be found, by vessels that have suffered from the strong head (northerly) winds that prevail along this coast, a comfortable harbor of refuge. Humboldt bay is, I think, the third harbor on this coast; it is sixteen miles long, and from three-quarters to four or five miles wide; the entrance between the breakers is nearly straight, but rather along the coast; it is about a mile long, and two hundred metres wide between the eighteen-foot curves on either side, with twenty-one feet at low water on the bar. It is perfectly accessible except in very heavy weather, when the sea breaks entirely across the entrance.”

More detailed information upon these harbors, and that of San Diego, and sailing directions for the latter, have been published, and will be found in the Appendix, (Nos. 45 and 50.)

The hydrography of the entrance and part of the bay of San Diego is given on the harbor map (sketch I, No. 7) already referred to under the head of topography.

Lieutenant Commanding Alden reports it as highly necessary to the safety of navigation in the harbor of San Francisco, that buoys should be placed on the Invincible and Blossom (sunken) rocks; and the expenditure is accordingly recommended. (For correspondence on the subject see Appendix No. 52.)

An examination has been made of the bay of Monterey, which is reported as completed, although the results have not yet been received. The schooner Ewing was detached for this duty.

Lieutenant Commanding Alden, in the steamer Quickstep, temporarily chartered for the purposes of the coast survey, has been engaged in a re-examination of the coast between San Francisco and Monterey; after concluding which, he has entered upon a continuance of the general coast reconnaissance from Monterey to our southern boundary. He will also prosecute, during this winter, the hydrography of the bay of San Francisco.

The draughtsman, Mr. McMurtrie, of the hydrographic party, de-

tached for the purpose, has furnished drawings (eye-sketches) of the entrance to Columbia river and of the neighboring coast.

The projected hydrographic operations in Oregon having been prevented by the loss of the steamer Jefferson, it is proposed to print the map of Columbia river entrance, and to send copies to the hydrographic party on the western coast, to be corrected there if the changes in the south channel are found to be of importance, and then to be published. Sailing directions for entering that river will be found in the Appendix, No. 51.

It is my painful duty to record the death of Passed Midshipman William De Koven, United States navy, an officer of high character, who had been but a short time attached to the coast survey. The letter of his commander, reporting his decease, is given in Appendix No. 53.

For the judicious execution of the hydrography on this coast a steam-vessel is essential. Hence the loss of the steamer Jefferson is severely felt. That vessel was so strained and dismantled by a gale off the coast of Patagonia, (proverbial for the severity of its storms,) that although, by God's mercy and by the well-directed exertions of her commander and crew, she was enabled to reach Port Desire in safety, it was necessary to abandon her there, since, even if repairs had been practicable, no facilities were accessible. In the Appendix (No. 54) will be found a report of the circumstances, and evidence that the vessel had been, after proper examination, approved as sea-worthy; had been properly fitted and provided; was commanded and worked with all the judgment and energy suitable to the occasion; and was finally abandoned through inevitable necessity. Her disastrous fate seems to be one of those cases in which the power of the elements defies all the efforts of human art and skill.

Lieutenant Commanding F. K. Murray, United States navy, was the commander of the Jefferson, and, before abandoning her, made satisfactory arrangements for saving and bringing home her boilers and machinery.

I take pleasure in quoting from a letter of Lieutenant Commanding Murray the following mention of the zealous and disinterested assistance afforded to himself, his officers and crew, by a stranger—the recital of whose conduct will insure him the admiration of every generous mind:

“It gives me pleasure to mention to you the noble conduct towards us of Mr. Henry Powell, the proprietor of the guano settlement—the generous sympathy, hospitality and friendly aid he extended to us during our protracted stay upon the coast of Patagonia. We soon became entirely dependent upon him for provisions, and these were furnished with his characteristic liberality. For many of them he would receive nothing; and for those furnished the government, charged nothing beyond the prices paid for them by himself. He scorned to take advantage of our necessities, and put himself and men upon short allowance that we might not want. This gentleman, endeared to all on board the Jefferson by his kindness, as well as by his social worth, is a native of Ireland.”

The steamer Corwin has been built for the coast survey out of the appropriation for the western coast; but the Jefferson was sent in her

place to save time, and the *Corwin* retained for the eastern coast. It will now be necessary to send the latter to replace the lost vessel in the Pacific, and the Treasury Department has directed her to be fitted out. Her withdrawal will be a serious loss to the eastern hydrography, and the interests of that work will require her to be replaced.

OFFICE WORK.

Every department of the office has, under the able supervision of Brevet Major I. I. Stevens, of the corps of engineers, continued to improve, and has filled the full measure required by the increasing number, amount, and variety of results returned by the field-work of the coast. For the first time every section under survey has reached that step when results are steadily returned and require provision for publication.

The progress of the work has rendered practicable arrangements for prompt publication, which, when it was less developed and executed on a smaller scale, were not possible. It is due to Major Stevens to acknowledge the promptness which is secured in the publication of results, and the maturing of a system by which sketches and preliminary charts are made in every case to precede the more finished work, furnishing valuable results to the navigator as soon as obtained by the surveyor.

The rapid execution of the engraved charts of the western coast reconnaissance is a proof of the perfection of this organization and of the zeal of those who administer it. Three well-executed sheets of reconnaissance were engraved and ready for publication within twenty working days after the beginning of the engraving. Preparations of a similar kind have been made to execute the charts of the southern portion of the same coast as soon as received, so that publications may be furnished early in the new year. The present report contains no less than three charts and thirty preliminary sketches, of immediate utility to navigators—the result generally of the work of the past surveying year.

It is, of course, understood that these latter do not pretend to be finished charts, but simply what their titles indicate—sketches, to be filled up and perfected as the work advances.

The divisions of the office-work are as follows: 1. Computing; 2. Drawing; 3. Engraving; 4. Electrotyping; 5. Printing; 6. Publishing, distribution, and sale; 7. Instrument making; 8. Archives and library.

The computing, drawing, engraving, and instrument making are each under the charge of an assistant, immediately responsible to the assistant in charge of the office, and directing, under his supervision, the details of each branch; the general direction, as a branch of the entire work, resting with the superintendent.

Major Stevens acknowledges, in his report, in complimentary terms, the services of assistant Hilgard, in charge of the computing department; of Lieutenant Richard H. Rush, United States army, in charge of the drawing department; of Joseph Saxton, esq., in charge of the instrument making; and of Lieutenant E. B. Hunt, of the corps of engineers, as his general assistant, now temporarily in charge of the en-

graving. Lieutenant A. A. Gibson, United States army, is also referred to in terms of warm commendation, for valuable assistance in the miscellaneous duties of the office.

The general result is thus referred to in Major Stevens' annual report: "It gives me pleasure to report that during the past year there has been a visible improvement of the office in all its branches, and it is my pleasure and duty to bear unqualified testimony to the zeal and efficiency of the several assistants in charge of the departments, and of the numerous employes under them. Each man has shown an honest purpose to do his duty; and I have been much oftener obliged to moderate exertion, than to rebuke indifference and neglect. These latter cases have been rare; and I speak advisedly when I say, I know of no person in the office, from assistant to laborer, who is not attentive and faithful in the discharge of his duties.

"It is fortunate that such has been the case; for the duties of the office have increased more rapidly than suitable assistance could be procured. Work for the first time has been devolved upon every branch of the office from each section of the survey; and the amount of work has not been small, growing out of a class of duties that was, by Congress, at its last session, assigned to the survey in connexion with the location of lights. No less than twelve engraved plates have resulted, the present year, from this entirely new class of duties; a fact in itself significant both of the amount of duty and the efficiency of the survey, both in the field and office.

"To Samuel Hein, esq., the general disbursing agent, I am under obligations for advice both in general and in special matters, which he is so well qualified to give from his great familiarity with the past history and the present condition of the work, and from his entire devotion to its best interests."

The records of the computing department have been systematized and the registers improved during the past year. The list of geographical positions, 3,240 in number, prepared for publication in a preliminary shape, is the best evidence of the zeal and ability of the gentlemen engaged in this part of the work. In the hydrographic portion of the work, reports have been made on the condition of the observations; the best methods of keeping, registering, and arranging them; and on the condition of the reductions; and have formed the basis of action in these matters.

The subject of current charts has been studied, and many tidal reductions have been made.

The arrangements in the drawing department have been improved by judicious arrangements and distribution of the duties, more in accordance with the special talent of the draughtsmen, in the division of the work, in the application of the system of contract, or of remuneration proportioned to the time of working, to such parts of it as admit of these arrangements. The condition of the department is represented by Major Stevens as very efficient, and the exertions of all employed in it are commended.

"Great exertions have been required to increase the force in this important department, (engraving,) and to classify their duties to meet the requirements of the survey.

"There are now eighteen engravers—five employed on a salary, one on a *per diem*, nine on contract, and three apprentices. Much of the work can best be done by contract; all the lettering and figures, views, sands, swamps, and even hills. Only one letterer is now employed on a salary; and to him is assigned the most difficult work, as titles and general lettering.

"The contract system has generally given satisfaction." Major Stevens speaks favorably of the improvement made by the younger members of this department, and of the zeal and fidelity of all.

It is due to the efficiency of the drawing and engraving departments that nearly the whole work of the past year is presented in sketches, with this report, to Congress. Major Stevens observes: "Our arrangements now are such that the work, as fast as it comes in, can be given to the public in preliminary sketches. Its effect will be great, both as an incentive to parties in the field, who see at once the fruits of their labor, and to the office force, in affording a better opportunity to train the younger members and prepare them for the finished charts. These sketches will, in most cases, be the finished charts, simply by the addition of the ornamental work.

"So the system of preliminary sketches and finished charts will actually hasten the publication of the latter, besides being the best system to apply, men having different degrees of skill; all, however, gradually rising to the highest excellence.

"The electrotyping department has improved so greatly the past year in all its arrangements and processes, that at my request its chief, Mr. Mathiot, has made a general report on the subject of electrotyping, (Appendix No. 55,) which I respectfully commend to your consideration.

"The advances which have been made through the agency of the Coast Survey have scarcely been equalled in the history of any art. Not a single failure has yet occurred in Mr. Mathiot's process. A single plate has again been reproduced from the junction of plates with complete success.

"The time for reproducing a plate has been greatly abridged. Time has been saved, and a greater certainty given to the process, by a heating apparatus, which is described in Mr. Mathiot's paper, and which is exhibited on the sketch accompanying his report. The work of this department the past year is not to be estimated by the number of plates made—16, all that were required by the wants of the survey—but by the great improvements that have been introduced—improvements necessary to meet the wants of the department the ensuing year. The sale of maps will, undoubtedly, soon be greatly extended.

"The time has come to call into action agencies for special sale of Coast Survey maps. They should be carried to each man's door having an interest in commerce, navigation, geography, and science. Mr. Mathiot can with certainty, in the present state of the art, reproduce his first basso in eight, and every subsequent basso in four days. These times may be reduced to six and three days. A plate has actually been made the past year, and returned to the engraving department, in sixty-five hours from the time the alto was sent to the electrotyping rooms. Certainly in fifty days the plates can be made for 15,000 sheets of any Coast Survey map, however large and elaborate

it may be: this shows the great practical utility of the process in the operations of the coast survey.

"Many of the plates will require three to four years' work of an engraver, and will cost from three to six thousand dollars. By the electrotyping process we can reproduce them in eight days, and at a comparatively trifling expense of some two hundred dollars."

A hydraulic press for map printing, intended to remedy the distortion which is now unavoidably produced, in a greater or less degree, by the copper-plate printing press, has been devised by Mr. Saxton, and is now in the course of construction under his direction.

The results obtained in the instrument shop, both in reference to the quality and economy, are very encouraging.

The arrangement of the archives has been much improved during the past year, in reference to registering, to completeness of detail in them when returned, and to facility of reference. Major Stevens again calls attention to the necessity for improved accommodations for the office of the survey. He remarks: "I again beg leave to call your attention not only to the pressing necessity of more extended accommodations for the safe-keeping of the archives, and for a probable increase in the business of electrotyping, printing, publishing, and sales, but to the unfitness of the present quarters for the purposes of drawing and engraving."

"I would recommend a suitable building as calculated to give a better tone to the whole establishment; making supervision more effective, giving better facilities for the furtherance of work, and abridging many expenses in the way of heating the rooms, and of repairs and attendance."

The following is a detailed account of the work done in the several branches, according to each of the officers engaged the credit for the results which he has forwarded:

1. COMPUTING.—The computing department has been under the charge of assistant J. E. Hilgard. Under his direction, the computations have kept up with the field-work sent to the office; the final reduction of the work of former years has made some progress; and the preparation of astronomical and geodetic results for publication has been brought to a state of forwardness. In Mr. Hilgard's absence his place has been ably supplied by Charles N. Schott, esq.

Mr. Hilgard, in his report, states that, "the project of work prepared at the beginning of the past year has been adhered to as nearly as circumstances would permit. The experience of the past will enable me to present a project for the ensuing year more definite in its provisions, and covering more fully the ground to be occupied."

Eugene Nulty, esq., has made the second computation of the latitude observations at Soper's, Hill's, and Webb's stations, Section III; with the zenith telescope, at east base Edisto island, Section V; at Point Conception and Point Pinos, Section X, with the zenith telescope; at Agamenticus, Section I, with the prime vertical transit; and azimuth observations at Breach inlet, Section V.

Assistant Th. W. Werner has computed the secondary triangulation of assistant Boutelle, in Massachusetts and Maine, 1850; the secondary triangulation of assistant Farley on the seacoast of Maryland and

Virginia, 1850; that of assistant Hilgard near Key West, 1851; and that of assistant Cutts in San Diego, 1851. He has also made the second computation of the latitude of Seaton station; has reduced prime vertical transits, observed at Nantucket, from 1846 to 1849; and has computed the azimuth observations at San Diego. Mr. Werner, having suffered from sickness and domestic affliction, has not been quite equal to the computations of the current geodetic work, some of which were made in the office.

Charles N. Schott, esq., has been chiefly engaged in the final reduction of the work of former years; and in the revision of latitude computations. He has reduced, by the method of least squares, the horizontal angles at thirty-four stations of the main triangulation in Sections II and III, and established the conditional equations of that work to 1850. He has verified and in part recomputed the computations of latitude at Seaton station, Point Conception, Soper's, Hill's, and Mount Independence. He has computed the azimuths observed at Soper's and Hill's stations, Section III; the secondary triangulation south of Cape Hatteras, 1851; and the latitude observations at San Diego. He has also prepared a report on terrestrial refraction, and has made some computations of magnetic observations. Mr. Schott has also devoted much time and rendered much valuable assistance in matters pertaining to hydrography, which will be referred to under its appropriate head. He has great aptitude for scientific investigation, whether pertaining to astronomical, magnetic, geodetic or hydrographical subjects, and his zeal and industry are fully equal to his ability.

Dr. G. Rumpff has been engaged in completing and perfecting the register of geographical positions, and preparing them for publication. He has also made a preliminary reduction of the primary triangulation, Section I, from 1846 to 1850; and the reduction of the conditional equation of the primary triangulation in Section III, north of Kent island base; has made the second computations of the triangulation of the Salem harbor; of assistant Williams' triangulations in Texas, 1851; of azimuth observations at Marriott's, Section III; and of latitude observations at Nantucket, in 1845 and 1846; and has revised the computations of the latitude of Shellbank, Section IV, and east base, Section V. Mr. Rumpff, throughout the year, has shown his customary diligence and exactness as a computer.

Mr. H. Ginder reported at the office in June, and has been chiefly engaged on computations of verification and adjustment, required in the preparation of geographical positions for publication. He is now (November) relieved from duty in the computing department, and assigned to the party of Mr. Gerdes, as aid.

Mr. M. H. Ober has made miscellaneous computations, under the immediate direction of Mr. Hilgard; and has computed the latitude of Nantucket from zenith distances, observed from 1846 to 1849. Mr. Ober has suffered from ill health during the greater portion of the year.

Mr. Keber has been on duty in the computing department since the 15th of October, and has made himself generally useful.

Mr. Fornaro also rendered service for a short period in the conversion of metre distances into yards and miles for the list of geographical positions.

Mr. Main joined the computing department on the 1st of November and from his high testimonials and the evidence of ability he has already shown, gives promise of future usefulness.

Mr. Hoover, one of the *élèves* of the Survey, has been employed in assisting Mr. Hilgard in the records, and in the simple computation, and has given entire satisfaction in the discharge of his duty.

The whole number of pages copied since November, 1850, is about 10,000, by an average of three copyists.

Hydrography.—Mr. Schott has devoted a considerable portion of his time to making reports and computations in connexion with the hydrography. Besides preparing several tide-tables for the published charts, he has made elaborate reports on the following subjects: on a thorough examination of the hydrographic work in the archives, including tides, currents, soundings, diagrams, and their registering, reducing, duplicating, arranging and binding; on directions for observing and reducing tides; on tides and currents in Hell Gate, and on the coast of New York and New Jersey; and on a method of representing currents. Besides the above, a number of reports on hydrographic matters, of less importance, have been sent in.

Lieutenants A. S. Baldwin and Wm. B. Whiting, and Passed Midshipman S. Nicholson, United States navy, and sub-assistant A. S. Wadsworth, and Mr. Jardella, have also been employed in tidal reductions.

2. DRAWING.—Since the 25th March, 1851, Lieutenant R. H. Rush, United States army, and assistant in the coast survey, has been in the permanent charge of this department. Lieutenant A. A. Gibson, United States army, and assistant in the coast survey, assigned to the duty of taking views for the published charts, has prepared the sketches for the list of geographical positions for Sections I, II, and III, brought up the back work on the diagram maps of Sections I, IV, and VIII, drawn the sketches accompanying the report on electrotyping, prepared titles, and arranged notes for the engraving department, and otherwise rendered important service in the drawing department.

Assistant W. M. C. Fairfax was occupied from the 1st of November, 1850, to the end of January, 1851, in the charge of the engraving department. Since then he has rendered invaluable assistance in the examination and elucidation of difficulties in the reduction of maps and charts. He has executed two sheets of topographical specimens, made a new scale of shades, and a partial report on the subject of lettering, all for the use of the office. He has also executed the principal work of the progress maps.

Assistant M. J. McClery continued in charge of the drawing department up to the 25th March, 1851, since which time he has been engaged principally upon the reduction of Chesapeake bay, No. II, scale $\frac{1}{80000}$. He has also been engaged upon maps showing the progress of the survey, in the verification of drawing, and in other miscellaneous matters.

Assistants Fairfax and McClery are especially commended for their great skill and intelligence, and for their conscientious and rigid discharge of duty. They are exemplars, both as artists and as men, in the department.

Mr. Welsh has been engaged nearly the whole time in the reduction

of Boston harbor, scale $\frac{1}{40000}$, which is now finished. He has also executed a part of the topography of Charleston harbor; made additions to the map of Long Island sound, and several excellent tracings.

Mr. Mahon was occupied upon the reduction of the topography of Mobile bay No. II, which he finished in June. Since then he has been at work upon the reduction of the topography of Salem harbor.

Mr. Luce has finished the topography of Albemarle sound, scale $\frac{1}{80000}$, and has executed the principal part of the hydrography. He has also made various right-line drawings, tracings, projections, and sketches for the annual report.

Mr. Ricketts has been engaged upon the hydrography of Mobile bay Nos. I and II, (No. II being finished,) hydrography of Key West, scale $\frac{1}{30000}$, and has finished the hydrography of the harbors of Huntingdon, Black Rock, Captain's island, East and West, Hart and City islands, Cawkin's island, and Sheffield island; has reduced the hydrography of the vicinity of the city of Savannah, and made an entirely new reduction of Nantucket shoals, and much other miscellaneous hydrography.

Mr. Boschke has completed the topography of Key West, scale $\frac{1}{50000}$, mouth of Columbia river, scale $\frac{1}{40000}$ and $\frac{1}{20000}$, and has made many projects, projections for plane-table and hydrographic parties, projections on copper, tracings, and annual report sketches.

Mr. Tennent was transferred to the engraving department in January, and previous to that time had been at work upon register maps, projections, &c.

Mr. Lambert has finished the topography of Wellfleet harbor, Hart and City islands, and Richmond island; and has been at work on the topography of Chesapeake bay No. I, and other miscellaneous matter. He has also executed some beautiful specimens of topography for use of the office. He has finished the New York current chart, and Charleston harbor chart, scale $\frac{1}{10000}$. He left the survey on the 30th September.

Mr. Fornaro has executed the topography of Galveston city and harbor, and has been engaged upon the topography of Beaufort harbor, tracings, projections, and annual report sketches. He has suffered much from sickness for the last three months.

This estimable gentleman died on the 4th November, after a lingering illness of three months. He was a major of topographical engineers in the Swiss service; suffered much from ill health since his arrival in this country, and departed with the esteem and regrets of all who knew him.

Mr. Forsyth joined the office in December, 1850, and was occupied upon register maps, history maps, and tracings, until May, 1851, when he left the office.

Mr. Walker joined the office in December, 1850, and was occupied upon register maps and projects until May, when he joined a plane-table party in the field. He was again attached to the office in November.

Mr. Townsend joined the office in August, and has rendered valuable assistance in making the progress maps. On the 15th October he was compelled to resign from ill health.

Mr. Hergesheimer joined the office on the 1st September, 1851, and has already proved a valuable addition to the department.

Mr. Hebst has executed several pieces of work on contract, and in a highly creditable manner.

Mr. Meyer, Mr. Neidlescioky, Mr. De Ahna, and Mr. Gritzner, have severally been employed for a few weeks in execution of various tracings and reductions upon contract

3. ENGRAVING.—This department was under the charge of assistant W. M. C. Fairfax till the close of January, when, at his own request, he was transferred to the drawing department. From that time till October it was under my direction, J. C. Tennent, esq., assisting me in matters of detail, since which time it has been under the charge of Lieutenant E. B. Hunt, corps of engineers and assistant in coast survey.

A.—The engraving of the following finished maps has been completed: 1. South side of Long Island, No. 1, by J. Knight, H. Knight, and O. A. Lawson; 2. Hart and City islands and Sachem's Head, by F. Dankworth, W. Smith, H. Knight, R. T. Knight, and J. V. N. Throop; 3. Hell Gate, by G. McCoy, F. Dankworth, and J. Knight; 4. Mobile entrance, (original and electrotpe,) by R. T. Knight, J. Knight, F. Dankworth, and W. Smith; 5. Richmond's Island harbor, (being the preliminary sketch filled in with topography,) by Wm. Smith, F. Dankworth, J. V. N. Throop, G. McCoy, and S. Siebert.

B.—The engraving of the following sketches and preliminary charts has been completed: 1—3. Reconnaissance chart, (McArthur,) western coast, by S. Siebert, J. V. N. Throop, W. Smith, J. Knight, R. T. Knight, O. A. Lawson, E. F. Woodward, G. McCoy, A. Rolle, and F. Dankworth; 4. Richmond's Island harbor, by Wm. Smith and J. V. N. Throop; 5. Nantucket shoals, by J. V. N. Throop, O. A. Lawson, J. Knight, and R. T. Knight; 6—8. Second edition (McArthur) western coast, by G. McCoy; 9. Hatteras inlet, (resurvey,) by W. Smith, R. T. Knight, and J. V. N. Throop; 10—14. Five diagram maps of Cat island tides, by J. V. N. Throop, R. T. Knight, T. D. Donohoo, H. Knight, and T. H. Oehlschlager; 15. Reconnaissance of Mosquito inlet, by G. McCoy, W. Smith, and T. D. Donohoo, (per contract); 16. Reconnaissance of Horn Island pass, by H. Knight, R. T. Knight, and T. D. Donohoo; 17. Point Conception, by H. Knight, W. Smith, J. V. N. Throop, and T. H. Oehlschlager; 18. Point Pinos and Bay of Monterey, by H. Knight, R. T. Knight, J. V. N. Throop, and H. C. Evens; 19. Mare Island straits, by W. Smith, J. V. N. Throop, G. McCoy, W. H. Dougal, H. Knight, R. T. Knight, and T. D. Donohoo; 20. Current chart of Boston harbor, by H. Knight and R. Knight; 21. Reconnaissance of Cedar keys, by J. V. N. Throop, R. T. Knight, and H. Knight; 22. Reconnaissance of the Delta of the Mississippi, by W. Smith, E. F. Woodward, G. McCoy, and J. V. N. Throop, (per contract); 23. Reconnaissance of Pass Christian, by H. Knight, J. V. N. Throop, W. Smith, T. D. Donohoo, and H. C. Evens; 24. Galveston bay, by H. Knight, J. V. N. Throop, R. T. Knight, and T. D. Donohoo; 25. Aransas Pass, by J. V. N. Throop, R. T. Knight, and T. H. Oehlschlager; 26. Trinidad bay, by G. McCoy, W. H. Dougal, and J. V. N. Throop; 27. Entrance of Columbia river, by E. F. Woodward; 28. Cape Hancock, by G. McCoy and Wm. Smith; 29. Holmes' Hole, by J. Acker-

man; 30—36. Seven maps of progress and geographical positions for annal report.

C.—The engraving of the following finished maps has been continued: 1. General coast chart, by F. Dankworth, O. A. Lawson, G. McCoy, and J. Knight; 2. No. 1, Long Island sound, by J. Knight, A. Rolle, O. A. Lawson, G. McCoy, and S. Siebert; 3. No. 1, Chesapeake bay, by O. A. Lawson and F. Dankworth; 4. Patapsco river, by O. A. Lawson and F. Dankworth; 5. No. 2, south side of Long Island, by O. A. Lawson and J. Knight; 6. No. 1, eastern series, by S. Siebert, J. V. N. Throop, and J. Knight; 7. Boston harbor, by A. Rolle, G. McCoy, H. M. Knight, and J. Knight; 8. Muskeget channel, by F. Dankworth, and E. F. Woodward.

D.—The engraving of the following finished maps has been commenced: 9. Charleston harbor, by E. F. Woodward, F. Dankworth, S. T. Pettit, and G. McCoy; 10. Key West, by E. F. Woodward, W. Smith, F. Dankworth, and H. M. Knight; 11. Connecticut river, by S. Siebert, G. McCoy, W. Smith, W. H. Dougal, and T. D. Donohoo; 12, 13. Nos. 1 and 2, Mobile bay, by F. Dankworth.

E.—The engraving of the following sketches and preliminary charts has been commenced: 1. Seacoast of Delaware and Maryland, (plate enlarged by electrotyping additional engraving work of hydrographic parties,) by W. Smith and J. Knight; 2. Beaufort harbor, by S. Siebert, J. V. N. Throop, H. M. Knight and R. T. Knight; 3. Humboldt bay, by W. Smith, T. D. Donohoo, and H. C. Evans; 4. Harbor of Key West, by A. Rolle, W. Smith, E. F. Woodward, R. T. Knight, H. M. Knight, and T. D. Donohoo; 5. Entrance of the Chesapeake, by S. Stull; 6. Re-engraving of Nantucket shoals, by J. H. Goldthwait; 7. Harbor of San Diego, by E. Yeager and T. D. Donohoo; 8. Entrance of San Francisco, by S. Siebert, E. F. Woodward, and J. V. N. Throop; 9. Savannah river, vicinity of Savannah, by J. V. N. Throop, H. M. Knight, T. H. Oehlschlager, T. Donohoo, and H. C. Evans; 10. Savannah entrance, by J. V. N. Throop and E. Yeager; 11. Mobile bay, by H. M. Knight, R. T. Knight, J. V. N. Throop, and H. C. Evans; 12. Bull's bay, (re-engraving,) by J. V. N. Throop, and T. Donohoo; 13. Entrance of Columbia river, by E. F. Woodward, W. Smith, J. V. N. Throop, and G. McCoy; 14—16. New edition of McArthur's chart of the western coast, by G. McCoy and W. Smith; 17. Point Pinos, (view,) by S. V. Hunt; 18. View of the mouth of the Columbia river, by G. McCoy; 19—26. Eight maps of progress and geographical positions.

ELECTROTYPING.—Mr. Mathiot has made, by the electrotyping process, during the past year, 16 engraved plates, all of which have been used by the printer. 1. Edgartown harbor; 2. New London; 3. New York (second electrototype copy); 4, 5, 6. Sheets Nos. 1, 2, 3, McArthur's chart of the western coast; 7. Sheet No. 2, McArthur's chart of the western coast (second electrototype copy); 8. No. 2, south side Long Island, (second electrototype copy); 9. Mouth of the Columbia river; 10. Seacoast of Delaware and Maryland, (greatly enlarged); 11, 12. Two copies of Hart and City islands, and Sachem's Head; 13. Sketch of Section IX; 14. Mobile entrance; 15, 16. Third and fourth electrototype copies of New York.

Mr. Mathiot has likewise furnished the engraving department 57 blank plates for engraving; inspected all the copper-plates purchased during the year; made eighteen metre scales by the electrotyping process; applied forty-two days' work, of ten hours each, to repairing magnetic and electric apparatus for the party employed in determining longitudes by the magnetic telegraph, and in partly making metallic thermometers for deep-sea temperatures. These thermometers are about two-thirds done, and have been suspended for want of material to complete them.

Two weeks have been occupied in removing the electrotyping apparatus to the building now occupied by it, and about twenty days in repairing derangements occasioned by the removal. Much time has also been occupied in renovations, changes, and the introduction of improved processes, as has been previously adverted to.

PRINTING.—Since the 1st of November, 1850, there have been printed from Delaware bay and river (electrotyping plate No. 1) 2,202 sheets, (this map consists of three sheets;) from the western part of the southern coast of Long Island, (electrotyping No. 2,) 1,274 copies; from the small map of the bay and harbor of New York, (electrotyping No. 2,) 650; No. 3, 600; No. 4, 600 copies; from the large map of New York bay and harbor, (original plates,) 300 sheets, (this map consists of six sheets); from the harbors of Cat and Ship islands, (electrotyping No. 1,) 520 copies; from the western coast reconnaissance, (original plates,) 1,842 sheets; (electrotyping No. 1,) 4,728 sheets, (this map consists of three sheets); from Pasquotank river, (electrotyping No. 1,) 333 copies; from Cawkins and Sheffield islands, (electrotyping No. 1,) 290 copies; from Hyannis harbor, (electrotyping No. 1,) 200 copies; from Hart and City islands and Sachem's Head harbor, (electrotyping No. 2,) 1,207 copies; from preliminary sketch of Richmond's island, (original plate,) 100 copies; from harbor of New London, (electrotyping No. 2) 250 copies; from Oyster or Syosset bay, (electrotyping No. 1,) 500 copies; from Huntingdon bay, (electrotyping No. 1,) 500 copies; making in all 16,096 sheets.

Besides these, there have been printed 891 copies from the annual sketch plates; 382 from Davis' New South shoal; 250 from the sea-coast of Delaware and Maryland; 426 from Hatteras shoals; 230 from Hatteras inlet; 30 from St. Andrew's shoals; 50 from Beaufort harbor; 375 from Cape Canaveral shoals; 600 tidal diagrams; 11,062 Cat island tides; 2,899 proofs of finished and unfinished plates and annual sketches; 325 circular protractors and scales of shades. There have also been 255 sheets antiquarian and 10 sheets double-elephant paper stretched in the printing office since the 1st of January, 1851.

PUBLISHING.—At the date of the last report 29 sheets of Coast Survey maps and 11 sketches had been published; these numbers have since been increased to 37 charts and 33 sketches.

Since November, 1850, there have been distributed, by direction of the Treasury Department, and for use in the survey, 1,104 sheets of Delaware bay and river, 554 copies of Hyannis harbor, 549 copies of Pasquotank river, 565 copies of harbors of Cat and Ship islands, and 1,704 sheets of the western coast. The whole number of sheets distributed is 4,476.

There have been turned over to the disbursing officer of the Coast

Survey, to be placed with agents for sale, 150 sheets of the large map of New York bay and harbor; 1,224 sheets of Delaware bay and river; 651 copies of small map of New York bay and harbor, 110 copies of New Bedford, 309 copies of Nantucket harbor, 162 copies of the harbors of Cawkins and Sheffield islands, 195 copies of Hyannis harbor, 234 copies of Pasquotank river, 348 copies of the harbors of Cat and Ship islands, 3,200 sheets of the western coast, 221 copies of the western part of the southern coast of Long Island, 587 copies of Hart and City islands and Sachem's Head harbor,—being in all, 7,391 sheets of maps.

INSTRUMENT MAKING AND REPAIRS.—The alterations, repairs, dividing and cleaning, required by the instruments of the field and office parties, generally, have been made during the past year under the direction of Joseph Saxton, esq.

Besides, there have been made two trestles for base apparatus, two deep-sea buckets, a telegraph cylinder, a ruling machine, a plane-table, three tripod stands for telescopes, six iron plummets, thirteen metre chains; a ten-inch vertical circle has been altered into a theodolite, theodolites repaired, heliotropes repaired and adjusted, sextants and drawing instruments repaired.

ARCHIVES AND LIBRARY.—Mr. C. B. Snow, in charge of the archives and library, has re-registered the original and duplicate geodetic work, securing simple and convenient reference; separated the hydrographic and topographic reductions of original maps into their appropriate sections, and opened a new register, arranged chronologically, with an alphabetical index; superintended the binding of the original and duplicate sounding and angle books; nearly finished arranging the hydrographic and topographic sheets in single tubes; superintended the force employed in copying sounding and tidal observations required to correct errors and complete duplicates, which duty will soon be completed; examined the returns of the permanent tidal observers, and reported as to completeness; and placed the library in condition for convenient use.

MISCELLANEOUS.—The foregoing office-work has been generally under the immediate direction of the assistant in charge of the office. I proceed to notice other office duties conducted under my own immediate superintendence.

The examination of the hydrographic work returned by the different parties, the revision of sailing directions and lists of dangers, the comparison of charts prepared at different periods, the general direction of tidal computations according to prescribed form, and various miscellaneous hydrographic work, would occupy the time and attention of an accomplished hydrographer, with several assistants. During the past year, much aid has been derived from the labors, under my immediate direction, of Lieutenant Wm. B. Whiting, United States navy, who was detailed for coast survey service in March last; in examining portions of the work in various sections, and in revising other portions, and in reporting on subjects occurring during the progress of reduction of the charts. He has also computed the tidal observations at seven stations, and has directed the reductions made by Passed Midshipman

Somerville Nicholson, United States navy, sub-assistant A. S. Wadsworth, and Mr. C. T. Jardella.

Professor Pendleton, United States navy, assistant in the coast survey, has, since his return from duty with the party of Lieutenant Commanding Woodhull, been engaged in the computations of moon culminations as observed in 1846 at Washington, Georgetown, Philadelphia, and Cambridge, with their corresponding ones in European observatories, for differences of longitude. He has also compared the results previously obtained for 1843, '44, '45, and '46, with the check computations of a second computer, and is employed in the observations of the same class made at San Diego, California.

The discussion of the tides at Cat island, Louisiana, and of Fort Morgan, Alabama, has been in progress under my immediate direction by Mr. W. W. Gordon, assisted by Mr. P. B. Hooe. I am indebted, also, for aid in this and other discussions of observations, to Lieutenant W. P. Trowbridge, of the corps of engineers, attached to my party. The tidal observations at Key West, and at Galveston, are under examination under my special direction.

Woods Baker, esq., has rendered useful aid in the office-work of the superintendent, both in the business work and scientific details.

Brevet Captain G. W. Lay, United States army, who was detached for coast survey service in December last, has been on special duty under my immediate direction during the greater part of the time, particularly in connexion with the names of positions; and has rendered valuable aid in the preparation of my annual report.

The disbursements under the charge of Samuel Hein, esq., and the business arrangements committed to him incidentally, have been made with an order and method, and care, which is characteristic of him. His experience in the details of the work, and his entire devotion to it, render his services of the highest value.

In conclusion, I present to the department those employed in the various branches of the survey, in the office, in the field, and afloat, as having executed faithfully the duties intrusted to them, and deserving the approval of the executive and legislative authorities.

Respectfully submitted by

A. D. BACHE,
Superintendent U. S. Coast Survey.

HON. THOMAS CORWIN,
Secretary of the Treasury.

CONTENTS OF APPENDIX.

No. 1. Distribution of the parties of the coast survey upon the coast of the United States, during the surveying seasons, in different parts of the coast, from November, 1850, to November, 1851.

No. 2. List of army officers on coast survey duty, September 1, 1851.

No. 3. List of navy officers on coast survey duty, March 1, 1851.

No. 3, *bis*. List of navy officers on coast survey duty, September 1, 1851.

No. 4. List of navy engineers on coast survey duty, March 1, 1851.

No. 4, *bis*. List of navy engineers on coast survey duty, September 1, 1851.

No. 5. Results of the coast survey at different periods from 1844 to 1851.

No. 6. List of coast survey discoveries and developments.

No. 7. Notes on a discussion of tidal observations made in connexion with the coast survey at Cat island, in the Gulf of Mexico, by Professor A. D. Bache, Superintendent of the Coast Survey.

No. 8. Method used in the coast survey of showing the results of current observations, by Professor A. D. Bache.

No. 9. Report of Professor O. M. Mitchel, director of the Cincinnati observatory, to the Superintendent of the Coast Survey, on a new method of recording differences of north polar distances or declination by electro-magnetism.

No. 10. Extracts from the report of Professor Agassiz to the Superintendent of the Coast Survey, on the examination of the Florida reefs, keys, and coast.

No. 11. List of coast survey maps, sketches and preliminary charts, engraved and engraving.

No. 12. List of geographical positions determined by the Coast Survey.

No. 13. Letter of the Secretary of the Treasury, communicating to the Superintendent of the Coast Survey the act of Congress requiring examinations to be made in relation to light-houses, light-boats, beacons, buoys, &c.

No. 14. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, applying for information in regard to the light-house matters referred to in the act of Congress.

No. 14, *bis*. Letters from the Secretary of the Treasury to the Superintendent of the Coast Survey, communicating reports from the Fifth Auditor in relation to light-house matters referred to in the act of Congress.

No. 15. Table showing the results of examinations for sites of light-houses, beacons, buoys, &c., referred to the Superintendent of the Coast Survey by the Secretary of the Treasury in accordance with the acts of Congress.

No. 16. Letter of the Superintendent to the chiefs of hydrographic parties in the coast survey, enclosing a communication of the secretary of the Light-house Board asking for suggestions for the improvement

and extension of the present light-house establishment; and extracts from their replies.

No. 17. Table of light-houses, beacons, buoys, &c., recommended by chiefs of hydrographic parties of the coast survey, for which no appropriations have been made.

No. 18. Letter of Sears C. Walker, esq., assistant in the coast survey, to the Superintendent, communicating an arrangement with the president of the Maine Telegraph Company to determine the difference in longitude of Cambridge and Halifax.

No. 19. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the result of an examination, by Lieutenant Commanding M. Woodhull, United States navy, assistant in the coast survey, into the necessity for certain aids to navigation on the coast of Maine, in accordance with the act of Congress and instructions of the Treasury Department.

No. 20. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating, with his approval, the recommendation of Lieutenant Commanding M. Woodhull, United States navy, assistant in the United States coast survey, to place a light-boat on Shovelful shoals.

No. 21. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding C. H. McBlair, United States navy, assistant in the United States coast survey, on the erection of "bug" or harbor lights at Holmes' Hole, Martha's Vineyard.

No. 22. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation required by act of Congress and instructions of the Treasury Department.

No. 23. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on ranges in New York harbor, with extracts from the report of assistant J. B. Glück.

No. 24. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation on the coast of New York and New Jersey required by act of Congress and instructions of the Treasury Department; and communicating the report of Lieutenants Commanding Jenkins and Woodhull.

No. 25. Report of Sears C. Walker, esq., assistant in the coast survey, communicating the measures of wave-time made from 1849 to 1851.

No. 26. Abstract of reports on longitudes by Sears C. Walker, esq., assistant in the coast survey, to the Superintendent.

No. 27. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Fishing Battery, in Chesapeake bay; and report of examinations by Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey.

No. 28. Extract from the report of Henry L. Whiting, esq., assistant in the coast survey, to the Superintendent, on the survey of Beaufort, North Carolina.

No. 29. Letter of the Superintendent of the Coast Survey to the

Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, upon the necessity for certain aids to navigation in Beaufort harbor, North Carolina.

No. 30. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, on the necessity for a light-house on the Upper Jetty, Cape Fear river.

No. 30, *bis*. Letter from the president of the Chamber of Commerce, of Charleston, South Carolina, to the Superintendent of the United States coast survey, requesting a tracing of the chart of Charleston harbor.

No. 30, *tris*. Report of the Superintendent of the United States coast survey to the Secretary of the Treasury, communicating sailing directions for the entrance into North Edisto harbor, by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

No. 31. Report of F. H. Gerdes, esq., assistant in the coast survey, to the Superintendent, on the reconnaissance of the coast of Florida, from the Suwannee river to the St. Martin's reef.

No. 32. Extracts from the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, to the Superintendent, of a reconnaissance of Mosquito inlet.

No. 33. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, in regard to the expediency of placing buoys in Mosquito inlet, Florida; and transmitting the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey.

No. 34. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon the necessity for a light-house or permanent beacon on the Rebecca shoal, between the Tortugas and Marquesas, coast of Florida.

No. 35. Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys and beacons for entrances to Mobile bay.

No. 36. Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys for Cat and Ship Island harbors.

No. 37. Letter of the Superintendent of the Coast Survey to James E. Saunders, esq., of Mobile, communicating sailing directions for Horn Island Pass.

No. 38. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on light-houses in Galveston bay.

No. 39. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-boat and buoys at Aransas Pass; and transmitting the report of the examination by Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey.

No. 40. Tribute of respect to the memory of Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

No. 41. Report of the Superintendent of the Coast Survey to the

Secretary of the Treasury, showing the most suitable site for a light-house at Point Conception, California.

No. 41, *bis*. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on the latitude and longitude of Point Conception, California.

No. 42. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of A. M. Harrison, esq., sub-assistant in the coast survey, on a site for a light-house on Point Pinos, near Monterey, California.

No. 43. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Point Loma, near San Diego, California; with the report of sub-assistant A. M. Harrison on the same.

No. 44. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of sub-assistant A. M. Harrison, of a survey of Cape Hancock or Disappointment for the location of a light-house.

No. 45. Extracts from a letter of Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, to the Superintendent, relating to Humboldt harbor and Trinidad bay, California.

No. 46. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of R. D. Cutts, esq., assistant in the coast survey, with sketches of his survey of Fort Point, at the entrance of San Francisco bay, and of Alcatraz or Bird island, within the bay, proposed as sites for light-houses.

No. 47. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, correcting important errors in the positions of the Farallones and Point Lobos, entrance to San Francisco bay.

No. 48. Report of Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, on the general character of the coast of California.

No. 49. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a letter from Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey, relating to the commerce of Columbia river.

No. 50. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating information relating to Trinidad, Humboldt, and San Diego bays.

No. 51. Sailing directions for entering the Columbia river as far as the harbor of Astoria, by Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey.

No. 52. Correspondence of the Superintendent of the Coast Survey with the Secretary of the Treasury, in relation to two sunken rocks in the harbor of San Francisco, reported by the collector of that port.

No. 53. Report of Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, to the Superintendent, of the death of Passed Midshipman William De Koven, United States navy, assistant in the coast survey, on the 31st of May, 1851.

No. 54. Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the loss of the steamer Jefferson on the coast of Patagonia, with documents relative thereto.

No. 55. Report to the assistant in charge of the Coast Survey office, on the electrotyping operations of the Coast Survey, by George Mathiot, electrotypist.

No. 56. Report of Lieutenant Commanding W. A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, of the examinations of the reefs in Hell Gate channel, and changes produced by blasting.

No. 57. Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon an examination in reference to a light-house at Humboldt harbor, California, made by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey.

No. 57, *bis*. Letter of the Superintendent of the Coast Survey to the Hon. Joseph Grinnell, of the Committee on Commerce, House of Representatives, communicating a report of Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey, on the importance of a light-house at Humboldt harbor.

LIST OF SKETCHES ACCOMPANYING THIS REPORT.

- A. Sketch of progress, Section 1.
A, No. 2. Nantucket shoals, re-engraved.
A, No. 3. Current Chart Boston harbor.
A, No. 4. Sketch of Holmes' Hole, showing proposed beacon.
- B. Sketch of progress, Section 2.
B, No. 2. Sketch of geographical positions, Point Judith to N. York.
B, No. 3. " " New York to Capes of
the Delaware.
B, No. 4. Sandy Hook changes.
B, No. 5. Beacon ranges.
- C. Sketch of progress, Section, 3.
C, No. 2. Entrance Chesapeake.
C, No. 3. Fishing Battery.
- D. Sketch of progress, Section 4.
D, No. 2. Hatteras shoals.
D, No. 3. Hatteras inlet.
D, No. 4. Gulf Stream soundings.
D, No. 5. Beaufort harbor.
D, No. 6. Progress of survey of Cape Fear river and vicinity.
D, No. 7. Fryingpan shoals.
- E. Sketch of progress, Section 5.
E, No. 2. Sketch of progress, Savannah river.
E, No. 3. Sketch of progress, north and south Edisto and St. Helena
sound.
E, No. 4. Savannah city.
E, No. 5. Savannah entrance.
E, No. 6. Bull's bay.
E, No. 7. North Edisto.
- F. Sketch of progress, Section 6.
F, No. 2. Sub-sketches of progress of work.
F, No. 3. Mosquito inlet.
F, No. 4. Cedar keys.
F, No. 5. Preliminary chart of Key West.
F, No. 6. Rebecca shoal.
- G. Sketch of progress, Section 7.
- H. Sketch of progress, Section 8.
H, No. 2-6. Cat Island tides.
H, No. 7. Horn Island pass.

H, No. 8. Delta Mississippi.
H, No. 9. Pass Christian
H, No. 10. Mobile bay.

I. Sketch of progress, Section 9.
I, No. 2. Galveston bay.
I, No. 3. Aransas Pass.

J. Sketch of progress, Sections 10 and 11.
J, No. 2. Mare Island straits.
J, No. 3. Point Conception.
J, No. 4. Point Pinos.
J, No. 5. Trinidad bay.
J, No. 6. Entrance San Francisco.
J, No. 7. San Diego.
J, No. 8. Humboldt bay.
J, No. 9. Sketch of progress San Francisco.
J, No. 10. Sketch of progress San Diego.
J, No. 11. Point Pinos view, incorporated into McArthur's chart.
J, No. 12, 13, 14. McArthur's chart, 4th edition.

K. Mouth of the Columbia river, showing site of light-house,
scale $\frac{1}{200000}$.

K, No. 2. Cape Hancock.

K, No. 3. Mouth of the Columbia river, scale $\frac{1}{400000}$.

X. Plate showing the electrotpe apparatus.

APPENDIX No. 1.

Distribution of the parties of the Coast Survey upon the coast of the United States, during the surveying seasons, in the different parts of the coast, from November, 1850, to November, 1851.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
I	Passamaquoddy bay to Point Judith, including the coast of Maine, New Hampshire, Massachusetts, and Rhode Island.	1	Primary triangulation and astronomical and magnetic observations.	A. D. Bache, superintendent; Lieut. W. P. Trowbridge, corps of engineers, and assistant; Geo. W. Dean, sub-assistant.	Mount Pleasant, Maine, occupied for geodetic and astronomical observations; Ossipee Mt., Maine, for geodetic, and Cape Small Point, Maine, for astronomical observations. (See also Section III.)
		2	Magnetic observations -	J. E. Hilgard, assistant -	Saco, Kennebunk, and Portland harbors.
		3	Reconnaissance -	C. O. Boutelle, assistant; Brevet Major Henry Prince, United States army.	Extension of primary stations beyond Penobscot. (Part of season; see also Section V.)
		4	Secondary triangulation -	Captain T. J. Cram, United States topographical engineers, assistant.	Sub-section from Portsmouth, New Hampshire, to Saco, Maine, completed and connected with primary triangulation.
			Secondary triangulation -	C. O. Boutelle, assistant -	Reconnaissance for secondary triangulation, Casco bay, Maine, part of season.
		5	Topography -	Alex. W. Longfellow, assistant -	Newburyport harbor, Massachusetts.
		6	Topography -	Henry L. Whiting, assistant; R. M. Bache, aid. (Double party.)	South and east shores of Cape Ann, Massachusetts, from Beverly Farms to Halibut Point. (See also Section IV.)
		7	Topography -	J. B. Gluck, assistant. (Double party.)	Chatham and vicinity, and Wellfleet, Cape Cod, Massachusetts. (See also Section III.)
		8	Hydrography -	Lieutenant Commanding Charles H. McBlair, United States navy, assistant; Lieut. Com'g Samuel Swartwout. (Double party.)	Nantucket shoals; Bass Rip; Davis' Bank; Fishing Rip; Muskeget channel, off Bond island; and Gay Head, Salem harbor, and its approaches.

II	Point Judith to Cape Henlopen, including the coast of Connecticut, New York, New Jersey, Pennsylvania, and Delaware.	9	Hydrography	-	Lieutenant Commanding Maxwell Woodhull, United States navy, assistant.	Newburyport harbor, Massachusetts; approaches to Portsmouth harbor, New Hampshire; Chat-ham harbor, Massachusetts; tides and currents of Vineyard sound, Buzzard's bay and passages connecting.
			Inspection	-	Brevet Major I. I. Stevens, corps of engineers, assistant.	Inspection of progress of certain parties during part of season.
			Special duty	-	Brevet Captain G. W. Lay, United States army, assistant.	During part of season.
		1	Triangulation	-	Edmund Blunt, assistant; Lieutenant Jos. S. Totten, United States army, assistant.	Hudson river, from limits of former work. (Part of season; see also Section III.)
		2	Topography	-	Henry L. Whiting, assistant	Re-survey of Sandy Hook to determine its changes. (Part of season.)
		3	Topography	-	J. B. Glück, assistant	Survey for ranges for Flynn's Knoll and Swash channel. (Part of season.)
		4	Hydrography	-	Lieutenant Commanding Maxwell Woodhull, United States navy, assistant.	Verification on south side Long Island, from Neapeague to Montauk, and eastward. Revision of entrance to Connecticut river. (See also Section I.)
		5	Hydrography	-	Lieutenant Commanding Samuel Swartwout, United States navy, assistant.	Off-shore work and tides and currents, between Gay Head and Cape May.
		6	Hydrography	-	Lieutenant Washington A. Bartlett, United States navy, assistant.	Minute survey of Way's reef, Pot Rock, &c., at Hell Gate, for changes by blasting.
		1	Primary triangulation and astronomical observations.	-	A. D. Bache, superintendent; Geo. W. Dean, sub-assistant.	Observations of latitude and azimuth at Causten's station, near Georgetown, D. C. (Part of season; see also Section I.)
III	Cape Henlopen to Cape Henry, including the coast of Delaware, Maryland, and Virginia.	2	Primary and secondary triangulation.	-	Edmund Blunt, assistant, and Lieut. J. S. Totten, U. S. army, assistant	Continuation of triangulation of Chesapeake, and preliminary determination to capes. (See also Section II.)
		3	Astronomical observations	-	Sears C. Walker, assistant	Longitude observations at Seaton station.
		4	Secondary triangulation	-	John Farley, assistant; George H. Bagwell, aid.	Outer shore of peninsula of eastern shore of Virginia, from Cedar island to Rogue's island.
		5	Reconnaissance	-	Brevet Major Henry Prince, U. S. army, assistant	To connect triangulation of Chesapeake and outer coast. (Part of season; see also Section IV.)

APPENDIX No. 1—Continued.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
III	Cape Henlopen to Cape Henry, &c.—continued.	6	Topography -	J. B. Glück, assistant	Verification work on Patapsco river and eastern shore. (Part of season; see also Section I.) Eastern (Chesapeake) shore of Maryland and Virginia, from Sykes' island to Rose Mary; and western shore, from Smith's Point L. H. to Wolf Trap station. (See also Section V.) Outer shore of peninsula of eastern shore of Maryland and Virginia. Same work during part of season. (See also Sections VIII and IX.) Inspection of work on Patapsco.
		7	Topography -	John Seib and S. A. Wainwright, sub-assistants. (Double party.)	
		8	Topography -	George D. Wise, assistant, and Mr. J. A. Denny.	
			Topography -	J. M. Wampler, sub-assistant, and Mr. Wm. M. Johnson.	
			Topography -	Brevet Major I. I. Stevens, corps of engineers, assistant.	
		9	Hydrography -	Lieut. Commanding John J. Almy, U. S. navy, assistant.	
IV	Cape Henry to Cape Fear, coast of Virginia and North Carolina.	10	Hydrography -	Lieut. Commanding B. F. Sands, U. S. navy, assistant.	Outer coast, from Lonesome Hill, Maryland, to South Gargathy, Virginia; and Chesapeake bay. Middle Ground entrance to Chesapeake bay. (Part of season; see also Section VIII.) Reconnaissance of Pamlico and Core sounds, &c. (Part of season; see also Section III.) Connexion of Forbes' Point, near Elizabeth city, and Seaton station, Washington, for difference of longitude. Currituck sound, nearly to the Virginia line. Entrance to Cape Fear river, (N. C.) (See also Section V.) From Cape Hatteras (N. C.) south to Ocracoke inlet. Beaufort Harbor (N. C.) and approaches, &c. (Part of season; see also Section I.)
		1	Reconnaissance -	Brevet Major Henry Prince, U. S. army, assistant.	
		2	Astronomical observations	L. F. Pourtales, assistant -	
		3	Secondary triangulation -	J. J. S. Hassler, assistant -	
		4	Secondary triangulation -	Charles P. Bolles, assistant, and Mr. J. W. Gregorie.	
		5	Tertiary triangulation -	A. S. Wadsworth, sub-assistant, and Mr. Charles Jardella.	
		6	Topography -	H. L. Whiting, assistant -	

IV & V	Gulf Stream - -	7	Hydrography -	Lieut. Commanding T. A. Jenkins, U. S. navy, assistant.	Fryingpan shoals, near Cape Fear river, (N. C.) (Part of season; see also Sections IV and V.)
		8	Hydrography -	Lieut. Commanding Richard Wainwright, U. S. navy, assistant.	Albemarle, Roanoke, and Croatan sounds, completed; Currituck sound commenced.
		9	Hydrography -	Lieut. Commanding J. N. Maffitt, U. S. navy, assistant.	Entrance to Cape Fear river, (N. C.) (Part of season; see also Section V.)
		-	Hydrography -	Lieut. Commanding T. A. Jenkins, U. S. navy, assistant.	Exploration of Gulf Stream—continued.
V	Cape Fear to St. Mary's river, including coast of South Carolina and Georgia.	1	Primary and secondary triangulation.	C. O. Boutelle, assistant; Lieut. Jos. S. Totten, U. S. army, and Mr. J. W. Gregorie.	East and west ends of Edisto base (S. C.) occupied; lines opened; secondary triangulation of North Edisto and Dawho rivers; reconnaissance for secondary triangulation to Stono river.
		2	Astronomical observations.	C. O. Boutelle, assistant; Prof. Lewis R. Gibbes.	Difference of longitude of Charleston and Savannah stations.
		3	Secondary triangulation -	C. P. Bolles, assistant, and Mr. Geo. A. Fairfield.	South Edisto and Ashepoo rivers and St. Helena sound. (See also Section IV.)
		4	Secondary triangulation -	C. O. Boutelle, assistant, and Mr. J. W. Gregorie.	Preliminary triangulation of entrance to Savannah river. (Close of season.)
		5	Topography -	Geo. D. Wise, assistant, and Mr. J. A. Denny.	South Edisto entrance and river, and Edisto island, near east end of base. (See also Section III.)
		6	Topography -	S. A. Wainwright, sub-assistant -	Harbor of Savannah and approaches. (During part of season; see also Section III.)
		7	Hydrography -	Lieut. Comm'g J. N. Maffitt, U. S. navy, assistant.	Charleston harbor completed; North Edisto harbor of refuge completed; harbor of Savannah completed. Preliminary survey of entrance to Savannah river.
		1	Inspection of parties -	A. D. Bache, superintendent -	Inspection of progress of parties in Section, &c.
		-	Reconnaissance -	F. H. Gerdes, assistant, and Mr. Henry Ginder.	Preparation of sites of bases; connexion of Tortugas and Marquesas, Cedar Keys, and Crystal river harbor, &c. (See also Section VIII.)
		-	Secondary triangulation -	F. H. Gerdes, assistant -	Triangulation of Cedar Keys and vicinity, and of Crystal river harbor, commenced.
VI	St. Mary's river to St. Joseph's, coast of Florida.	2	Secondary triangulation -	J. E. Hilgard, assistant -	Triangulation of Florida keys, from Key Biscayne to Soldier key. (Part of season; see also Section I.)
		3	Secondary triangulation -	L. F. Pourtales, assistant, Lieut. Jas. Totten, U. S. army, assistant, and Mr. Ethelbert Mason.	Triangulation of Florida keys continued from Soldier key to Turkey key. (Part of season; see also Section IV.)

APPENDIX No. 1—Continued.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
VI	St. Mary's river to St. Joseph's, &c.—Continued.	4	Topography	J. H. Adams, sub-assistant, and Mr. R. M. Bache. (Double party.)	Marquesas, &c., Bahia Honda, &c., Key Biscayne and main, to limits of triangulation, completed. (See also Section I.) Key West harbor and approaches completed; Boca Grande, Bahia Honda, reconnaissance of Musquito inlet, (eastern coast of Florida.) Station points secured. (Part of season; see also Section VI.)
		5	Hydrography	Lieut. Comm'g John Rodgers, U. S. navy, assistant.	
	Mobile bay to Vermillion bay, coast of Alabama, Mississippi, and part of Louisiana.	1	Primary triangulation and secondary triangulation.	F. H. Gerdes, assistant, and Mr. Henry Ginder.	
		2	Secondary triangulation	S. A. Gilbert, assistant	
VIII		3	Topography	W. E. Greenwell, assistant, and Mr. Wm. M. Johnson.	Revision of previous work and extension westward into Lake Borgne; Biloxi and St. Louis bays triangulated; signals placed in Lake Borgne and on eastern shore Pontchartrain. West Pascagoula river, Mississippi, to Biloxi bay and Back bay; Pass Christian, from Pitcher Point to Henderson's Point. Eastward and westward of Mobile entrance; Pass Christian; reconnaissance of Southwest Pass and Pass à l'oultre, mouths of Mississippi. Bonsecours bay, near entrance of Mobile bay. (Part of season.) From Base on Galveston island, Texas, and Highland bayou, westward to "Peninsula" station. Head of Galveston bay; entrance to San Jacinto river; delta of Trinity river and Turtle bay;
		4	Hydrography	Lieut. Comm'g B. F. Sands, U. S. navy, assistant.	
			Hydrography	Lieut. Comm'g Jas. Alden, U. S. navy, assistant.	
		1	Primary and secondary triangulation.	Jas. S. Williams, assist., and Spencer C. McCorkle, sub-assistant.	
		2	Topography	Sub-assistant J. M. Wampler	
X	Vermillion bay to the boundary, part of Louisiana and Texas.				

X & XI	Coast of California and Oregon.	3	Hydrography	Lieut. Comm'g T. A. M. Craven, U. S. navy, assistant.	East and West bays, near entrance of Galveston bay, to limits of triangulation. (See also Section III.)
∞		1	Main and secondary triangulation.	R. D. Cutts, assistant	Galveston entrance, approaches and Lower bay.
		2	Geographical determinations.	Geo. Davidson, assistant, and Mr. John Rockwell.	Determination of Farallones; entrance to San Francisco bay; San Diego harbor.
		3	Topography	Richard D. Cutts, assistant, and Mr. Augs. S. Rodgers.	Latitude and longitude of Point Pinos, Monterey, California; of Point Loma, San Diego, California; of Cape Disappointment, Columbia river, Oregon; diff. long. San Francisco and Cape Disappointment.
					North and south sides of entrance to San Francisco bay; Mare island, for site for fortification and navy yard; sites of light-houses at entrance to San Francisco bay, on Farallones, and on Bird island.
			Topography	A. M. Harrison, sub-assistant, and Mr. J. L. Lawson.	Sites of light-houses at Point Conception, at Point Pinos, (Monterey,) at Point Loma, (San Diego, California,) and at Cape Disappointment, (Oregon,) and Point Adams, Oregon.
		4	Hydrography	Lieut. Comm'g Jas. Alden, U. S. navy, assistant.	Trinidad bay and river; Humboldt bay, California; views of entrance to Columbia river; general reconnaissance of the coast south of San Francisco; hydrography of the harbor of Monterey; and continuation of reconnaissance of coast south of Monterey.

APPENDIX No. 2.

A list of army officers on Coast Survey duty, September 1, 1851.

Name.	Rank.	Date of attachment.
Thomas J. Cram.....	Captain topographical engineers.....	December 7, 1846
Henry Prince.....	Captain and brevet major 4th infantry.....	December 10, 1850
Isaac I. Stevens.....	1st lieutenant and brevet major engineers.....	September 14, 1849
Augustus A. Gibson.....	1st lieutenant 2d artillery.....	January 17, 1851
James Totten.....	1st lieutenant 2d artillery.....	December 10, 1850
William M. Gardner.....	1st lieutenant 7th artillery.....	February 1, 1851
Richard H. Rush.....	1st lieutenant 2d artillery.....	December 10, 1850
Joseph S. Totten.....	1st lieutenant 2d artillery.....	December 10, 1850
George W. Lay.....	1st lieutenant and brevet captain 6th infantry.....	December 10, 1850
Edward B. Hunt.....	2d lieutenant engineers.....	May 5, 1851
William P. Trowbridge.....	2d lieutenant engineers.....	April 18, 1851

APPENDIX No. 3.

List of navy officers on Coast Survey duty, March 1, 1851.

Vessel.	Locality of service.	Name	Rank.	Date of attachment.
Steamer Bibb.....	Office.....	C. H. McBlair.....	Lieut. commanding.	April 11, 1849
		H. A. Wise.....	Lieutenant.....	Oct. 8, 1849
		C. St. Geo. Noland.....	do.....	May 29, 1850
		F. S. Conover.....	Passed midshipman.	Feb. 21, 1851
Schooner Madison.....	Office.....	M. Woodhull.....	Lieut. commanding.	Mar. 30, 1848
		E. A. Barnet.....	Lieutenant.....	Sept. 8, 1849
		J. H. March.....	Passed midshipman.	1850
		G. H. Bier.....	do.....	July 30, 1850
Steamer Corwin.....	Office.....	Wm. Van Wyck.....	do.....	1850
		T. A. Jenkins.....	Lieut. commanding.	Feb. 17, 1849
		J. S. Taylor.....	Lieutenant.....	July 18, 1850
		A. S. Baldwin.....	do.....	Jan. 9, 1849
Schconer Gallatin.....	Office.....	W. A. Bartlett.....	do.....	May 29, 1848
		S. Nicholson.....	Passed midshipman.	Oct. 17, 1849
		J. N. Maffitt.....	Lieut. commanding.	Feb. 8, 1851
		Daniel Ammen.....	Lieutenant.....	1850
Steamer Hetzel.....	Section 5.....	J. D. Bullock.....	Passed midshipman.	Aug. 29, 1849
		J. D. Langhorne.....	do.....	May 29, 1850
		A. C. Rhind.....	do.....	Nov. 27, 1848
		John Rodgers.....	Lieut. commanding.	Apr. 27, 1849
	Section 6.....	J. D. Read.....	Lieutenant.....	1850

APPENDIX No. 3—Continued.

116

2. Dec. 3.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
Steamer Hetzel	Section 6	J. Walcutt.....	Passed midshipman ..	May 29, 1850
		J. Myers	do.....do.....	May 29, 1850
		N. T. West	do.....do.....	
Steamer Walker	Section 8	B. F. Sands	Lieut. commanding..	May 29, 1850
		M. C. Watkins	Lieutenant.....	Mar. 12, 1851
		W. W. Roberts.....	Acting master.	
		A. N. Lynch	Assistant surgeon ...	August, 1850
		Jno. B. McCauley.....	Passed midshipman ..	October, 1850
Schooner J. Y. Mason	Section 4	Jos. Fry.....	do.....do.....	1850
		R. Wainwright	Lieut. commanding..	Dec. 6, 1849
		W. A. Webb.....	Acting master	Oct. 9, 1850
		Jos. D. Dannels	Passed midshipman ..	1850
		E. Renshaw	do.....do.....	1850
Schooner Morris.....	Section 9	T. A. M. Craven	Lieut. commanding..	Jan. 29, 1851
		C. E. Fleming.....	Lieutenant.....	1850
		D. Bryan.....	Passed asst. surgeon ..	October, 1850
		T. Pattison	Acting master	October, 1850
		L. H. Lyne	Passed midshipman ..	October, 1850
Schooner Ewing	Sections 10 and 11	J. H. Moore	Acting master	1850
		B. R. Mitchell.....	Assistant surgeon ...	1848
		Wm. De Koven	Passed midshipman ..	Dec. 5, 1850
		Wm. Gibson	do.....do.....	Nov. 29, 1848
		Jas. Alden.....	Lieut. commanding ..	Mar. 19, 1849
On their way to join party.				

Steamer Jefferson.....	T. H. Stevens.....	Lieutenant.....	Mar. 12, 1851
	R. M. Cuyler.....	Passed midshipman..	Aug. 16, 1847
	F. K. Murray.....	Lieut. commanding..	1850
	C. W. Place.....	Acting master.....	Jan. 14, 1851
	Chas. Martin.....	Assistant surgeon...	Dec. 31, 1850
	W. H. Wilcox.....	Passed midshipman..	May 29, 1850
	G. Cilley.....	do.....do.....	1850
	D. P. McCorkle.....	do.....do.....	Aug. 12, 1848

APPENDIX No. 3 bis.

List of navy officers on Coast Survey duty, September 1, 1851.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
Steamer Bibb.....	Section 1.....	C. H. McBlair.....	Lieut. commanding..	Apr. 11, 1849
		H. A. Wise.....	Lieutenant.....	Oct. 8, 1849
		C. St. Geo. Noland.....	do.....	May 29, 1850
		Leo. Paulding.....	Acting master.....	May 1, 1851
		W. S. Bishop.....	Assistant surgeon...	May 3, 1851
Brig Washington.....	Section 1.....	F. S. Conover.....	Passed midshipman.	Feb. 21, 1851
		S. Swartwout.....	Lieut. commanding..	May 3, 1851
		G. W. Doty.....	Lieutenant.....	May 2, 1851
		J. D. Bullock.....	Acting master.....	Aug. 29, 1849
		J. L. Davis.....	Passed midshipman.	May, 1851
Schooner Madison.....	Sections 1 and 2.....	Maxwell Woodhull..	Lieut. commanding..	Mar. 30, 1848
		G. H. Preble.....	Lieutenant.....	Aug. 26, 1851
		E. A. Barnet.....	do.....	Sept. 8, 1849
		J. H. March.....	Acting master.....	1850
		S. F. Cowes.....	Assistant surgeon...	May 16, 1851
Steamer Legaré.....	Section 3.....	G. H. Bier.....	Passed midshipman.	July 30, 1850
		John J. Almy.....	Lieutenant commd'g.	Mar. 12, 1851
		Thomas M. Crossan..	Lieutenant.....	May 1, 1851
		T. S. Phelps.....	Acting master.....	May 1, 1851
		J. S. Gilliam.....	Assistant surgeon...	May 5, 1851

Schooner Graham	Section 3	W. W. Low	Passed midshipman .	April 7, 1851
		Horace N. Crabb	...do.....do.....	April 1, 1851
		J. E. Jouett	...do.....do.....	April 1, 1851
		N. B. Harrison	Acting master	May, 1851
		Richard L. Law	Passed midshipman .	May 11, 1851
		William Van Wyck.		
Schooner Gallatin	Section 4	J. N. Maffitt	Lieutenant comm'ng.	Feb. 8, 1851
		Daniel Ammen	Lieutenant.	
		A. C. Rhind	Acting master	March 9, 1846
		J. D. Langhorne	Passed midshipman .	Jan. 1, 1851
		T. A. Jenkins	Lieutenant comm'ng.	March 9, 1846
Steamer Corwin	Section 4	John S. Taylor	Lieutenant	March 9, 1846
		Paul Shirley	Acting master	June 24, 1851
		R. A. Marr	Passed midshipman .	May, 1851
		S. P. Quackenbush ..	...do.....do.....	July 3, 1851
		T. Barraud	...do.....do.....	July 29, 1851
		Charles F. Hopkins ..	...do.....do.....	July 26, 1851
Schr's Nautilus & Meredith ..	Section 3	B. F. Sands	Lieutenant comm'ng.	March 9, 1846
		M. C. Watkins	Lieutenant	Mar. 12, 1851
		W. W. Roberts	Acting master.	
		A. N. Lynch	Assistant surgeon ...	March 9, 1846
		J. B. McCauley	Passed midshipman .	October, 1850
		William L. Powell ..	...do.....do.....	Aug. 2, 1851
		S. S. Bassett	...do.....do.....	April 2, 1851
Schooner Ewing	Sections 10 and 11	James Alden	Lieutenant comm'ng.	March 9, 1846
		T. H. Stevens	Lieutenant	Mar. 12, 1851
		Benjamin R. Mitchell.	Assistant surgeon.	
		R. M. Cuyler	Passed midshipman .	Aug. 16, 1847
		William Gibson	...do.....do.....	Nov. 29, 1848

APPENDIX No. 3 bis—Continued.

Vessel.	Locality of service.	Name.	Rank.	Date of attachment.
	On the way home from the wreck of steamer Jefferson.	F. K. Murray.....	Lieutenant.....	1850
		C. W. Place.....	Acting master.....	Jan. 14, 1851
		Charles Martin.....	Assistant surgeon...	Dec. 31, 1850
		W. H. Wilcox.....	Passed midshipman..	May 29, 1850
		G. Gilley.....	do.....do.....	1850
		D. P. McCorkle.....	do.....do.....	Aug. 12, 1848
		John Rodgers.....	Lieutenant comm'ng..	March 9, 1846
Steamer Hetzel.....	Office.....	J. D. Read.....	Lieutenant.....	March 9, 1846
		J. Myers.....	Passed midshipman..	March 9, 1846
		Rich'd Wainwright...	Lieutenant comm'ng..	March 9, 1846
Schooner J. Y. Mason.....	Office.....	William A. Webb.....	Acting master.....	March 9, 1846
		T. A. M. Craven.....	Lieutenant comm'ng..	Jan. 29, 1851
		L. H. Lyne.....	Passed midshipman..	October, 1850
		W. B. Whitney.....	Lieutenant.....	April, 1851
		A. S. Baldwin.....	do.....do.....	Jan. 9, 1849
		W. A. Bartlett.....	do.....do.....	May 29, 1848
		S. Nicholson.....	Passed midshipman..	Oct. 17, 1849

APPENDIX No. 4.

List of Assistant Engineers United States navy on Coast Survey duty, March 1, 1851.

Vessel.	Name.	Rank.	Date of attachment.
Steamer Hetzel.....	H. Mason.....	Second assistant engineer.....	1850.
Steamer Walker.....	S. B. Knox.....	Third assistant engineer.....	1850.
	James G. Young.....	Second assistant engineer.....	1850.
	R. C. Potts.....	Third assistant engineer.....	1850.
	M. Fletcher.....	Third assistant engineer.....	1850.
Steamer Jefferson.....	B. F. Garvin.....	First assistant engineer.....	January, 1851.
	R. H. Long.....	Second assistant engineer.....	January, 1851.
	W. A. Nones.....	Second assistant engineer.....	January, 1851.
	W. H. Rutherford.....	Third assistant engineer.....	January, 1851.
Steamer Legaré.....	J. Alexander.....	First assistant engineer.....	1850.

APPENDIX No. 4 bis.

List of Assistant Engineers United States navy on Coast Survey duty, September 1, 1851.

Vessel.	Name.	Rank.	Date of attachment.
Steamer Bibb	D. B. Macomb.....	Third assistant engineer.....	May 29, 1851.
Steamer Legaré	E. S. De Luce.....	Third assistant engineer.....	May 29, 1851.
	J. M. Adams.....	Third assistant engineer.....	May 6, 1851.
	W. H. King.....	Third assistant engineer.....	May 8, 1851.
	W. J. Lamdin.....	Third assistant engineer.....	May 23, 1851.
Steamer Corwin	T. Kilpatrick.....	Second assistant engineer.....	May 12, 1851.
	A. Lawton.....	Second assistant engineer.....	May 12, 1851.
	W. S. Stamm.....	Third assistant engineer.....	May 13, 1851.
Steamer Jefferson	B. F. Garvin.....	First assistant engineer.....	January, 1851.
	R. H. Long.....	Second assistant engineer.....	January, 1851.
	W. A. Nones.....	Second assistant engineer.....	January, 1851.
	W. H. Rutherford.....	Third assistant engineer.....	January, 1851.

APPENDIX No. 5.

Results of the Coast Survey at different periods, from 1844 to 1851.

	From 1844 to 1850.	For 1850.	Total from beginning of survey.
Reconnaissance, area in square miles.....	23,760	3,280	36,680
Reconnaissance parties, No. of.....	.....	4	6
Base lines.....do.....	4	1	13
Preliminary base lines.....do.....	8	3	81½
Base lines, length of, in miles.....	44½	17½	23,905
Triangulation, area in square miles.....	12,732	2,097	1,169
Extent of coast line.....	554	305	8,948
Extent of shore line, reckoning bays, sounds, &c.....	4,831	902	2,120
Horizontal angles, stations, &c., No. of.....	946	157	64
Vertical angles, stations.....do.....	35	13	45
Triangulation parties.....do.....	.....	18	21
Latitude stations.....do.....	30	6	35
Longitude stations.....do.....	18	2	54
Azimuth stations.....do.....	22	4	106
Latitude stations.. } extra { ..do.....	.....	2	
Longitude stations. } ..do.....	.....	6	
Astronomical stations.....do.....	38	7	
Astronomical parties.....do.....	.....	5	
Magnetic stations.....do.....	97	9	
Magnetic parties.....do.....	.....	4	

	From 1844 to 1850.	For 1850.	Total from begin- ning of survey.
Meteorological stations, No. of.....	11	5	16
Meteorological parties.....do.....	.....	2	9,621
Topography, area in square miles.....	3,107	292	11,873
Length of shore line in miles.....	5,005	768	28,173
Topographical parties, No. of.....	.....	11	2,353
Hydrography, area in square miles.....	16,197	2,353	10
Hydrographical parties, No. of.....	.....	264,323	2,288,496
Hydrography, number of soundings.....	1,216,026	24	1,434
Gulf Stream, number of soundings for temperature.....	1,410	914	140,661
Gulf Stream, number of fathoms line.....	139,747	12	141
Tidal stations, temporary, No. of.....	60	15	107
Tidal stations, permanent...do.....	61	11	337
Tidal parties.....do.....	.....	44	2
Current stations.....do.....	293	292	5,176
Current parties.....do.....	.....	72	735
Specimens of bottom.....	4,384	24	183
Total number of manuscript maps.....	337	21	301
Of these, number prepared in office.....	130	30	483
Original topographical maps, No. of.....	120	13	200
Containing sheets.....	155	.....	37
Original charts.....	84	.....	.....
Duplicates (charts).....	3	.....	.....

Containing sheets.....	188	28	452
Records, triangulation, base, &c., No. of vols.....	271	40	410
Astronomical observations.....do.....	168	30	215
Astronomical differences of longitudes.....do.....	107		
Computations, geodetic.....do.....	179	8	266
Computations, astronomical.....do.....	148	16	170
Magnetic observations.....do.....	40	5	49
Magnetic computations.....do.....	21	.....	21
Geodetic books (duplicate).....do.....	147	23	197
Meteorological books.....do.....	10	.....	10
Meteorological books (duplicates).....do.....	3	.....	3
Original hydrographical books, soundings, and angles, No. of vols.....	514	170	863
Duplicates of same.....do.....	44	12	83
Hydrographic books, tidal and current observ's, and tidal reductions, No. of vols.....	221	62	291
Total records.....do.....	1,870	424	2,742
Volumes in the library.....do.....	750	590	1,340
Engraved plates of maps, No. of.....	35	10	50
Engraved plates electrotyped.....do.....	12	25	37
Published maps.....do.....	27	6	33
Printed sheets of maps.....do.....	39,411	6,773	46,184
Printed sheets of maps distributed,.....No. of.....	9,526	326	9,852
Printed sheets of maps, for sale by agents.....do.....	19,794	3,115	22,909
Instruments, value of.....	\$157,893	\$4,652	\$162,491

APPENDIX No. 6.

List of Coast Survey discoveries and developments.

The true object of the survey is to furnish charts of the coast for purposes of commerce, and making known what was previously unknown. In the course of preparing these, important discoveries are made.

1. Gedney's channel into New York bay, having two feet more water in it than the old channels.

Had the true depth of this channel been known in 1778, the French fleet under Count D'Estaing would have passed into the bay and taken the assembled British vessels. It is probable, from comparing the old and new charts, that this channel then existed.

2. Blake's channel into the Delaware; open when the eastern channel is filled with ice. This discovery has already developed the resources of that part of the State of Delaware in a remarkable way.

3. Davis' South shoal, discovered in 1846, six miles south of the old Nantucket South shoals. This shoal lies in the track of all vessels between New York and Europe, and between New England and the southern States, or New England and South America.

4. Davis' Bank.

5. Two feet more water in Mobile bay than existed six years ago. Mobile entrance has near $20\frac{3}{4}$ feet at low water.

6. Horn Island channel, on the coast of Mississippi.

7. Blunt's channel, in Delaware bay.

8. Numerous rocks in Long Island sound and Martha's Vineyard sound, and the various bays and harbors connected with them.

9. Two shoals north and east of Nantucket, discovered in 1847.

10. Six shoals near Nantucket, the outermost one $14\frac{1}{2}$ miles from land and having but ten feet of water on it; not marked on any existing chart.

11. The remarkable increase of Sandy Hook, which has been traced from the surveys of the topographical engineers and coast survey.

12. The changes in the Delaware, near the Pea Patch.

13. A shoal at the mouth of the Great and Little Choptank, in the Chesapeake bay.

14. McBlair's shoals, off Nantucket, in 1849.

15. Deeper water found on Diamond shoal, and a dangerous nine-foot shoal off Cape Hatteras, 1850.

16. Hetzel shoal, off Cape Canaveral, 1850.

17. New channel into Key West.

18. New channel into Charleston, with same depth of water as the ship-channel, (Maffitt's channel,) 1850.

19. South channel of Columbia river, surveyed and rendered available to commerce.

20. A channel of $2\frac{1}{2}$ fathoms, upwards of a mile wide, distant 11 nautical miles from Bald Head light-house, across the Frying Pan shoals, Cape Fear, N. C., 1851.

21. A channel extending from 3 to 4 miles from the point of Cape

Fear to 8 to $8\frac{1}{2}$ from it, with sufficient water at low tide to allow vessels drawing 9 to 10 feet water to cross with safety.

22. A channel at the distance of 14 nautical miles from Bald Head light-house, one mile wide, with $3\frac{1}{2}$ to 7 fathoms water on it.

23. The Frying Pan shoals extend to the distance of 20 nautical miles from Bald Head light-house.

24. Sixteen, 17, and 18 feet water found at the distance of 17 and 18 nautical miles from the Bald Head light-house.

25. Broad Sound channel into Boston harbor thoroughly surveyed, and marks recommended to facilitate passage through it, 1848.

APPENDIX No. 7.

Notes of a discussion of tidal observations, made in connexion with the Coast Survey, at Cat island, in the Gulf of Mexico, by Professor A. D. Bache, Superintendent of the Coast Survey. (See sketches H, Nos. 2 to 6 inclusive.)

In executing the hydrography of the entrance of Mobile bay and of Mississippi sound, connected tidal observations were made under the immediate direction of Lieutenant Commanding C. P. Patterson, United States navy, assistant in the Coast Survey.

The observations at Cat island, at the entrance to Lake Borgne, Louisiana, and at Fort Morgan, at the entrance to Mobile bay, have undergone more than one discussion, the peculiarities of the tides giving great interest to the observations.

The results, as obtained from a year's hourly observations, day and night, at Cat island, will be given as far as obtained, the steps taken for further progress stated, and the information which has been obtained from other sources, bearing upon this most interesting problem of the tides in the Gulf of Mexico, will be briefly touched upon.

I hope, in the progress of the survey along this part of our coast, to develop the subject of these tides, full of importance to the navigator, and of interest to the man of science. These tides, with special exceptions, ebb and flow but once in twenty-four hours.

The tide-gauge was of the kind known as the box-gauge, with a float and staff, graduated into feet and decimals of a foot. It was placed in the harbor of Cat island, near the light-house, at the extremity of a temporary wharf.

The harbor, as the Coast Survey chart which I now present to the meeting shows, turns its widest and deepest opening to the east.

Apparent time was given by a mark, and the observations were made at mean solar time by applying the equations. The time was of less consequence than ordinary in these observations, from the small rise and fall of the tide, which prevented small differences of time from being noticeable by differences of rise and fall. Slight inequalities, caused chiefly by wind, were also found to affect the observations so materially that it was not deemed advisable to observe oftener than once the hour; and after attempting to determine the epoch of hi

and low water by more frequent observations, it was decided that errors would probably be introduced by aiming at a degree of precision which the phenomena themselves did not present.

The observations were made day and night, hourly, for a year, with exceedingly rare omissions, and, as the discussion has shown, with a degree of faithfulness which merits very great praise. The observers were Messrs. Gustavus Würdeman and R. T. Bassett, attached to the coast survey.

The general opinion of nautical men on the subject of these tides is, that they mainly depend upon the action of the wind; and the very regular effect which may be shown to result from a discussion of the tides, in reference to the local action by the wind, lends plausibility to this generalization, which nevertheless is unfounded.

The causes are of a much more general character, and such as usually influence the tides, so modified as to be difficult to bring out; phenomena which are only accessory in the ordinary discussions assuming here the chief and overruling part.

The regular tabulation of the observations was made by Lieut. Commanding C. P. Patterson, who did not fail to perceive that the ordinary methods of discussion of the tides were inapplicable. His removal from the survey on other professional service has devolved upon me the labor of discussing the results.

Their importance, interest, and novelty, so far as our coast and their striking peculiarities are concerned, have justified me in giving much time to the discussion, which has been carried on, under my immediate direction, by Mr. G. W. Dean, sub-assistant in the coast survey, and by Messrs. R. M. Bache, A. S. Wadsworth, jr., and W. M. Johnson.

I am indebted for the diagrams necessary to illustrate the conclusions already arrived at, to Messrs. Bache, Johnson, and Keyser.

I present a part only of the labors of these gentlemen. The whole of the hourly observations for the year have been thrown into the form of curves, and numerous tables for examining and verifying the different hypotheses have been made by them. Though the subject was reached inductively, I do not propose to present it strictly in that form.

The work even now is far from being complete: indeed, we have rather reached the true method of discussion, than have completed the discussion; and we may yet have to modify our hypothesis, though I think not materially. I present it to the association as a work in *progress*. When the investigation for this station is made complete, the application of the methods to the other stations on the Gulf of Mexico will be in a degree mechanical.

It is curious that one among the earliest complete series of tidal observations on record, is of tides ebbing and flowing but once in twenty-four hours. The observations were made by Mr. Francis Davenport, at Batsha, of the tides on the bar of Tonquin, and communicated to Dr. Halley, who gave them, with a diagram connecting the phenomena with the moon's motion in the ecliptic, in the thirteenth volume of the Philosophical Transactions for the year 1683. Newton explained these tides by his lunar theory, but in a way, as appears to me, to leave it doubtful whether he supposed the interference of two ordinary or six-hour tides to produce the phenomena. These tides have been referred to since

by almost every writer of note, who has given a general theory of the tides.

The subject of the diurnal inequality of the tides has been so completely and ingeniously discussed by Mr. Whewell, Master of Trinity, that it may be said emphatically to be his own. He first pointed out the empirical law of variation of this inequality. The first distinct attempt to trace the cause of apparent ebb and flow once in twenty-four hours to the influence of the diurnal irregularity, is also, so far as I know, his. In discussing (Phil. Trans. for 1837, Part I) the tides at Singapore, where the diurnal inequality is very large, he was led to the conclusion, if carried a little further, "at a certain stage of it the alternate tides would vanish." To this effect he attributed the "single-day tides of King George's sound, on the coast of New Holland, as observed by Captain Fitz Roy," and gives the curves for a week's observations on the diagram accompanying his papers. The progress of the diurnal inequality wave along the coast of Europe forms an interesting part of Mr. Whewell's labors, the conclusions of which are given in the same volume of the Philosophical Transactions.

In all these cases, however, there are two tides in the course of the day, so as to bring out the diurnal inequality by the comparison of the consecutive high or low water. The subject is followed up in the eleventh series of tidal researches by Mr. Whewell, and in the appendix, in which the diagram of the tides of Petropaulofsk, in the bay of Avatcha, Kamschatka, approaching very nearly, at certain parts of the lunar month, to the order of single-day tides, is given, to prove that the diurnal inequality may be so large "as to lead to the appearance of only one tide in twenty-four (lunar) hours." The equations of the diurnal and semi-diurnal tide-waves are given in this paper, and the wave produced by certain cases of their interference is discussed. (Phil. Trans. for 1840.)

I do not pretend to give such notice of these important papers as would be necessary in a formal communication. Unquestionably the observations now under examination would have furnished to Mr. Whewell only the means of trying ideas and consequences flowing from those which have been already discussed by him; yet the forms of discussion are original, and perhaps new, and the conclusions present so much of novelty, that they remain to be fully put to the test by more elaborate discussion, and by bringing the results at other places to bear upon the same question. I am forced, by the necessity for brevity, to omit a reference to the learned, ingenious, and elaborate paper of Mr. Airy, in the Philosophical Transactions for 1848.

The small rise and fall of the tides, amounting on the average to but one foot, would seem to make it difficult to obtain the law of the phenomena, even with the aid of the most careful and truthful observations—the class to which those under discussion have proved to belong. In regard both to time and height, we may expect to be baffled by small irregularities, requiring long continuance of observations and comparisons of means to get rid of. Thus far few cases have occurred which do not exhibit more striking coincidences than differences.

1. To show the time of high or low water in such a way that the discussion might be readily generalized, the diagrams, of which a specimen

is before the association, were made, (Pl. 3, or H No. 2.) The hours of the day are the ordinates, and the days of the month the abscissa. The signs H and L show in their proper place the hour of occurrence of high and low water for each day. The time of the moon's superior transit is marked, and the periods of greatest declination, and of crossing the equator. The result is easily generalized, that there is ordinarily but one high and one low water at Cat island in twenty-four (lunar) hours, and that when there are two tides they occur about the time of the moon's crossing the equator, and are usually most regular and strongly marked when in syzgies, with declination nearly zero. Following one set of high and low waters, it will be found that they occur later and later as the lunar day gains on the solar, with very remarkable differences, of which the explanation will be given towards the period of small declinations. The interval from high to low water is generally less by some hours than that from low to high. That as the moon approaches the equator, there are a few days of singular double tides, or of single tides, in which the times from low to high water are very much increased. That when the declination changes its name, a high tide takes nearly the place of a low in time, and *vice versa*, with an interval of irregularity; or, in other words, the tides are displaced by nearly twelve hours.

2. There is, as Mr. Whewell has remarked, no proper establishment to be derived from such tides; yet, we may obtain a desirable datum by throwing the results into the form of tables, in which the luni-tidal intervals are arranged according to the days from the zero of declination and the corresponding superior and inferior transits, and for north and south declinations. This will be made more clear by subsequent explanation. These afford a test of the theory of these tides by showing the displacement of the ordinate of high and low water, and might be used for the inverse purpose of forming prediction tables. Such tables of luni-tidal intervals for three months I now submit. They show considerable steadiness and similarity of intervals towards the maximum of declinations and great variations near the zero, and greater discrepancies than is usual in ordinary tides. These are from a series of tables computed by Mr. R. M. Bache for the year, and containing the times of high and low water, deduced from the daily curves, the readings of the gauge, the rise and fall of the tides, the times of the moon's superior and inferior transit, and the moon's declination.

The intervals serve to show that the high water belongs alternately to the superior and inferior transits of the moon, according as the moon's declination is north or south, with a few cases only which admit of doubt. Two sets of luni-tidal intervals were computed (see tables) for three months, to ascertain the proper epoch of reduction, or age of the tide. In one case, the intervals were referred to the superior transit of one day before; and in the other, to the superior transit of two days before. The square of the discrepancy of the mean in the latter case was greater than in the former. An establishment deduced from these numbers for high-water, without correction, would have a probable error, as tried by discrepancy from the mean, of nearly eighty-four minutes. I have little doubt of being able to reduce this error, by computation, much within the limits of observation, so as to give useful

prediction tables. The foregoing results point distinctly to a ruling cause depending upon the moon's declination.

3. The hourly observations for the year were thrown into the form of curves—the abscissas representing the hours, and the ordinates the heights. Of these I present, as characteristic, the months of January and March, (Pl. 4, 5, or H, Nos. 3, 4.) In January the tides are single throughout the month, the rise and fall diminishing towards the zero of declination; and in March, two periods of marked double tides occur. The times of new and full moon coincide nearly with the zero of declination of March; in January the syzigies occur at times of greatest declination. A series of diagrams, prepared for periods of declination zero, show irregularities, or double tides, near these times. Before disappearing, the tide which is lost appears rather as an irregularity than as a real tide, puzzling to the observer, and a severe test of his faithfulness. A similar set of diagrams for the periods of greatest declination show uniformly single tides and the greatest comparative rise and fall at the same periods, whether coinciding with syzigies or with first and last quarters. In computing the heights of spring and neap tides by the common methods, four months gave zero or negative differences.

To discuss the epochs of the phenomena, as compared with greatest and least declinations, I prepared two sets of tables, which require revision. They show sometimes an actual coincidence in the epoch of least tides and zero of declination—sometimes a precedence and sometimes a subsequence—which, when not caused by irregularity of winds, I believe will find a satisfactory explanation; at a mean, there was little advantage in the discussion found from displacing the epoch. The average rise and fall for the second day before the greatest declination was 1.68 feet; for the day next preceding the greatest declination 1.78; for the day of greatest declination 1.81; for the next day 1.86; and for the next 1.77. Tracing a curve from these would give the epoch of greatest rise and fall about 0.75 days after the greatest declination. The average rise and fall on the corresponding days, in reference to declination zero, were 0.96 feet, 0.75, 0.60, (dec. zero,) 0.63, 0.73, the curve giving the epoch about one-sixth of a day after the zero of declination. The numbers, as stated, require revision; and there are causes for apparent displacement, which require further examination.

4. This general examination tends to point to the diurnal irregularity, as Mr. Whewell has stated, as the cause of the occurrence of these single-day tides; a view which is confirmed by such examinations as I have been able to make of the hourly tidal observations at Fort Morgan, at the entrance of Mobile bay. The interference in this case would be between the diurnal tide-wave, which represents the diurnal inequality, and the ordinary semi-diurnal wave; whether this wave has a regular progress along the coast, independently of the semi-diurnal wave, as was at first supposed by Mr. Whewell, or whether its phenomena are local, as he has since been led, from his investigations, to believe. If the observed wave is produced by its interference with a semi-diurnal wave, we can only study the phenomena to advantage after the observed wave has been separated into its components.

5. As a first approximation, I assumed the two waves to be governed by the law of sines, and then determined the curve which would result from the superposition of two such waves, having the same or different origins. The mean of the regular double tides, about the zero of declination, would present a first approximate value of the rise and fall of the semi-diurnal tides, and the mean of double and single tides, at the maximum of declination, would, especially when near the quadratures, give a first approximation to the height of the diurnal tide. The comparisons with the forms of curves already traced, addressing the eye, are easily made.

I present, herewith, diagrams (Pl. 6, or H No. 5) for the case, in which the maximum of the diurnal tide coincides with that of the semi-diurnal; is three hours in advance, (or coincides with mean water falling,) six hours (or coincides with low water,) and nine hours, (or coincides with the second mean, or mean water rising,) using the approximate quantities referred to above for the greatest height of two component curves. It requires little examination to see that neither of the first three forms represents the case, and that the fourth does so remarkably, even in what appear to be small irregularities in the daily curves. This will be seen in the results for October, of which a diagram on a large scale is presented, giving the tidal curves near the zero, and thence up to the maximum of declination, for the first half of the month. In the single-day tides there was the same slow rise compared with fall; sharp rise and fall near high and low water, with the tendency to a stand during the rise; the same excess in the interval of time from low to high water, over that from high to low water. This hypothesis as to the position of the two waves may perhaps be slightly improved by further discussion. It is obvious, from the equation of the curve, (which I have already referred to, as given by Mr. Whewell,) that the form and position of remarkable points will vary with the constants in the component curves, as well as with the position of the origin of each in reference to that of the other.

To carry out the representation graphically, I have drawn the curves for four values of the constants of the diurnal and semi-diurnal, formed from the observations with the same displacement of nine hours in the time of high water of the diurnal curve, and corresponding to the epochs of the maximum declination, two, four, and six days before or after the maximum. These show the general features of the curve sufficiently, and the variations in the times and heights, the passage from single to double tides, and the reverse; and the coincidence with observations is such as to warrant a close numerical discussion.

6. The equation of the curve shows how much the time of high and low water depends on the constants in the diurnal and semi-diurnal curve.

The equivalent of the equation given by Mr. Whewell is—

$$C. \cos 2t + D \cos (t - E) - y = 0,$$

in which t is the time in hours from the place of the maximum ordinate of the semi-diurnal curve as an origin; C is the constant of that curve of sines; E is the distance of the maximum ordinate of the diurnal curve

for the former, and D the constant for the curve of sines; y is the ordinate of the complex curve.

By an easy transformation, this takes the form—

$$2 C \cos^2 t + D \cos t \cos E + D \sin t \sin E - C = y.$$

$$\text{For } E=9 \text{ hrs. } \cos E = -\sin E = -\sqrt{\frac{1}{2}},$$

$$\text{and } y = 2 C \cos^2 t + D \sin E (\sin t - \cos t) - C.$$

The differential co-efficient of which for the case of the maximum or minimum is—

$$\frac{dy}{dt} = -4 C \cos t \sin t + D \sin E (\sin t + \cos t) = 0$$

$$\frac{1}{\sin t} + \frac{1}{\cos t} = \frac{4 C}{D \sin E} = \frac{4 C}{D \sqrt{\frac{1}{2}}},$$

or, since the second term is negative when $t > 6$ hours,

$$\operatorname{cosec} t - \sec t = \frac{4 C}{D \sqrt{\frac{1}{2}}}.$$

Applying this to the four cases shown in the diagrams—

	hrs.	min.
E=9 hours, C=0.175, D=0.700, we find maximum at.....	10	25.4
=0.615	10	33.3
=0.400	10	51.1
=0.157	11	56.8

and for the intervals between high and low water in lunar hours, 9h. 09.2m., 8h. 53.4m., 8h. 17.8m., and 6h. 06.4m.

We might apply this mode to test the hypothesis, using for the values of C the half difference of the ordinates of six and twelve hours from the mean, and of eighteen and twenty-four hours with the signs changed; and for D, the average of the ordinates of six and eighteen hours from the first mean. The means present the best criterion, because not displaced in this combination, as the equation shows. This mode of proceeding, however, throws the test too much on the weak part of the results—the times of occurrence of high and low water, or of mean water—and does not take in all the points of the curve; and I have, therefore, preferred a different form of discussion.

7. Placing the maximum of the semi-diurnal curve at 0 hours, in the hypothesis that the high water of the diurnal curve is nine hours in advance of that of the semi-diurnal curve, the two curves cross the line of mean water at three hours, the diurnal curve rising and the semi-diurnal falling; at six hours, the semi-diurnal curve has reached its maximum, and rises again at nine hours to its intersection with the mean water-line, at which time the diurnal curve has reached its maximum; the semi-diurnal curve attains its greatest rise at twelve hours, and the mean level at fifteen; the diurnal curve also descending to the same point at that time.

Within these two intervals from mean level to mean level, the combinations of the ordinates forming the actual tidal curve are exhausted; the part of the curve below the mean level being symmetrical with the above: from three to nine hours, the ordinates of the semi-diurnal curve as subtractive; from nine to fifteen hours additive. The mean is the average between high and low water. The tides of each day will give the forms of the component curves, beginning with the mean,

and ending with it, considering as symmetrical the parts above and below the axis of X.

In tabulating, the branch above the axis should be referred to the mean of the preceding and succeeding low water $\left\{\frac{1+1}{4} + \frac{h}{2}\right\}$ and of the high-water which it includes, and that below to the mean of the two high and of one low-water. From three to nine hours, the difference of the ordinates giving the actual curve, and from fifteen to nine in the reverse order, the sum of the same ordinates, half the sum of the two series of ordinates gives the value of the ordinates of the semi-diurnal curve. The same being repeated with the second branch of the curve, the average will give two results for each day's observation.

The case given in the table on the board, for March 5, will serve to illustrate the simple nature of this method of proceeding.

The mean ordinate for the first and second branches of the curve having been obtained, and the hourly observation which coincides most nearly with it having been found before and after high-water, the hourly observations are arranged from it forwards for seven hours (m.) and backwards for seven (n.) The same is done for low-water (m' and n'.) The half sums and half differences are taken in each case, and then the means. The computation of the diurnal curve is made in the upper part of the table, and that of the semi-diurnal curve in the lower part. The number representing the mean level is eliminated by the mode of taking the means in each table, and the ordinates below the axis are treated as if having the same sign as those above. The semi-diurnal curve is turned over on its maximum ordinate, and the mean value of a single branch of it found. Then each curve is reduced to zero, in the mean level of the period. The last two columns of the upper and lower part of the table contain, respectively, the curves of sines corresponding to the diurnal and semi-diurnal curves.

In the case shown in the first diagram, the ordinates of the semi-diurnal curve from mean water to high-water, and corresponding nearly to a minimum of declination, and new moon, are 0.00 feet, + 0.02, + 0.03, + 0.05, + 0.04, — 0.02, + 0.02. The moon's declination during the period being about from $2^{\circ} 54'$ S., to $1^{\circ} 45'$ S., this curve obviously contains a residual of the semi-diurnal curve, not taken out; but supposing it to be deduced from a just mean, the corresponding ordinates of a semi-diurnal curve, calculated with 0.04 feet as the maximum, would be 0.00 feet, 0.01, 0.02, 0.03, 0.03, 0.04, 0.04, differing, at the most, 0.06 of a foot, or about three-quarters of an inch, and, in a single instance, the sum of all the six differences being .03 feet, and the average .004.

The ordinates of the semi-diurnal curve are 0.00 feet, 0.14, 0.28, 0.32. The curve of sines computed with the greatest ordinate has, in this case, for its corresponding ordinates, 0.00 feet, 0.16, 0.28, 0.32, differing but .02 feet at the greatest.

At the next period of declination, nearly zero and full moon in the month of March, the ordinates of the diurnal curve deduced are 0.00 feet, 0.05, 0.06, 0.06, 0.08, 0.06, 0.09, and the corresponding computed ordinates 0.00 feet, 0.02, 0.04, 0.06, 0.07, 0.09, 0.09, differing at the greatest 0.03 feet, and on the average, 0.004 feet, the observed ordi-

nate being this time in excess, as it was before in defect. The ordinates of the semi-diurnal curve are 0.00 feet, 0.12, 0.22, 0.26, and the computed ones 0.00 feet, 0.13, 0.24, 0.26, the greatest difference being 0.02 feet, and the average 0.007 feet in excess, as was the former.

For March 12, corresponding to the maximum of the diurnal curves, and to neap tides, (one day after last quarter,) the ordinates of the hourly diurnal curve from mean to high-water, are 0.00 feet, 0.21, 0.36, 0.51, 0.63, 0.69, 0.71, the corresponding ordinates of the curve of sines being 0.00 feet, 0.18, 0.35, 0.63, 0.69, 0.71, in which the greatest difference is 0.03 feet, and the mean $+ 0.007$ in the curve computed from observation. The ordinates of the semi-diurnal curve are each zero. Two days afterwards, viz: March 13, gives for the diurnal curve, 0.00 feet, 0.18, 0.34, 0.47, 0.61, 0.68, 0.74, corresponding to which is the curve of sines, 0.00 feet, 0.18, 0.37, 0.51, 0.63, 0.72, 0.74, in which the greatest difference is 0.04 feet, and the mean $- 0.02$ feet, the curve of observation having the least ordinates. The semi-diurnal curve is 0.00 feet, 0.00, 0.03, 0.02.

The average of three months taken by weeks, gives, for the mean curve and curve of sines, the following table :

	DIURNAL CURVE.			SEMI-DIURNAL CURVE.	
	From observation.	Of sines.	Difference.	From observation.	Of sines.
<i>Hours.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>	
0	0.00	0.00		0.00	0.00
1	0.17	0.15	0.02	0.04	0.04
2	0.32	0.30	0.02	0.07	0.07
3	0.43	0.42	0.01	0.08	0.08
4	0.52	0.52	0.00		
5	0.56	0.58	0.02		
6	0.58	0.60	0.02		
Sum.			0.01		

These results are shown by a curve in the diagram herewith presented (Pl. 7, or H. No. 6,) on the full scale, the greatest difference between the curve from the observation and the curve of the sines being less than a quarter of an inch in the mean, deduced from three months' observations. Whether this will disappear in the mean of more observations, or whether a modification of the hypothesis of displacement of nine hours must be made to meet it, further computations now in progress will show.

8. When this analysis has been made as complete as possible, and applied to the year's observations, it will remain to take up the two series into which we have divided the observations, and to discuss them numerically in detail, as we have heretofore done, generally, in

regard to the known laws of the diurnal irregularity, and of the ordinary tides.

Each determination gives a corresponding value of the maximum, or of the ordinate of high water, and in the case of the mean of the curves for January, February, and March, these maxima are 0.66 feet, 0.65, 0.60, 0.60, 0.58, 0.58. Mean 0.61 feet, differing .03 of a foot from the maximum found directly from the observations, and if the discrepancies are accidental, giving a mean probable error by the variations from the average of 0.02 feet (one-quarter of an inch) of any one of the determinations, and for the mean, 0.01 feet nearly.

9. By the kindness of Colonel Abert, of the topographical engineers, of Major Bache, of the same corps, and of Lieutenant Maury, superintendent of the National Observatory, I have been put in possession of tidal registers which have been kept during the progress of the local surveys made of harbors on the coast of the Gulf of Mexico. The tidal observations of Major Bache, United States topographical engineers, at Key West and the Tortugas, are the most complete of this series, and show, as a general phenomenon, the prevalence of the semi-diurnal wave at that point. I have not yet had the opportunity to examine fully these results, which are, however, under discussion.

APPENDIX No. 8.

Method used in the Coast Survey of showing the results of current observations, by Professor A. D. Bache, Superintendent.

This method, while it is original, may not be new, though I am not aware that the system has been followed by others. It has some analogies with the representations of Berghaus, but is different essentially from them. The principle, and an application to the very elaborate current observations made in Boston harbor, under the immediate direction of Lieut. Charles H. Davis, by Lieut. J. N. Maffitt, are shown in the diagrams now presented to the Association.

Observations of the direction and velocity of the currents at and below the surface have been extensively introduced into the hydrography of the coast survey; their importance needs no remark. For most of the details of arrangement and suggestion in regard to the earlier observations, I am indebted to my brother, the late Lieut. Geo. M. Bache, U. S. N.; for much of the success of execution to Lieuts. Charles H. Davis and Carlisle P. Patterson, U. S. N., who have taken unwearied pains in the matter. For currents below the surface there is still wanted some sure and easy method of determining both direction and velocity, especially the latter elements.

Observations being multiplied at different periods of the current, from slack-water to slack-water, they are projected upon diagrams, showing at a glance the direction and velocity at any particular station. The average of the results is usually obtained by inspection. Dividing the intervals between slack-waters into quarters, we give the mean results for those periods in a table, and place usually upon the chart arrows

indicating the direction or set, and write at the extremity, numbers showing the velocity or rate in miles per hour. In case of the observations made in Boston harbor, the results are so unusually numerous that the lines of direction were confusing to the eye, and the connexion between the results was very difficult to seize, though from the pains taken, the motion of the water was traceable in nearly all its peculiarities, from the entrance through the tortuous passages among the islands, alternately narrowing and expanding to the city wharves.

In the current chart now brought before the Association, the direction and force of the currents are represented by lines, the distance between which is inversely as the rate in miles per hour. The scale was obtained by making the least velocity correspond to nearly half an inch, and the greatest to 0.06 of an inch. The reciprocals of the number of miles per hour are represented by tenths of inches in the diagram, currents of 0.2, 0.5, 1, 1.5, 2 miles per hour being represented by lines parallel to their directions, and distant 0.5, 0.2, 0.1, 0.67, 0.05 of an inch. The chart is on a scale of $\frac{1}{200,000}$. The representation on one of the diagrams corresponds to the *flood*, and in the other to the *ebb*, referring to the motion of the current from slack-water to slack-water. If the current stations were very numerous, the straight lines tangent to the curves of motion of the water (set of the current) would become curves.

It is easy for the navigator to seize the relations of the currents he will meet, even by these tangent lines, to avail himself of the knowledge this imparts of the direct, lateral, and eddy currents, to avoid danger or secure advantage.

The cause of the change of directions and velocities is in most cases well marked, the generalization presented to the eye being connected with the form and position of the land above or below the water. In some cases the chart indicates that the observations should be repeated; and in others that, numerous as the stations are, they should still be increased in number. Its adoption will probably thus react, to improve the observations upon which it is founded.

APPENDIX No. 9.

Report of Professor O. M. Mitchel, Director of the Cincinnati Observatory, to the Superintendent of the Coast Survey, on a new method of recording differences of north polar distances, or declination, by electro-magnetism.

DEAR SIR: I have delayed thus far sending you any detailed account of the new methods of astronomical observation in use at the Cincinnati Observatory: partly because the subject was constantly developing by new experiments, and partly because at the New Haven meeting of the American Association for the Advancement of Science, this subject, at my request, was referred to a committee for examination. The report of this committee having now been made, and the whole subject having assumed (by another year's examination and experiment) a more definite and positive form, it is now proper to present some general features of this new method, some results already

reached, and the probable applications which remain to be made when suitable instruments shall have been provided for the purpose.

Observers are well aware of the difference between observations for right ascension and declination. In the first the principle of *repetition* has been extensively introduced, with the best results; while as to the other, reliance is mainly placed on the accuracy of a single bisection of the star observed on one declination wire. More than two years since a plan had been executed by myself, and applied to practice in the Cincinnati Observatory, by which, on the same night, during one and the same transit, a star or other heavenly body could be observed on *ten* declination wires, with all the precision due to a single observation by the old methods. More than a year has elapsed since I presented to the American Association some three thousand observations, taken in twelve nights by the new apparatus (a number exceeding the recorded observations of a whole year at one of the oldest European observatories.) Each of these observations presented an accuracy superior to those obtained by the old methods.

This astonishing rapidity and accuracy gave rise to a debate, and, finally, to the appointment of the committee above alluded to. A multitude of observations have been made during the past year, (and in accordance with the request of the chairman of this committee,) varied, with a view to test in every way the powers of the new machinery. The results, as will be seen by examining the report of the committee, were entirely satisfactory.

It is proper now to state, that by the new invention, the transit instrument is converted (at trifling expense) into a declinometer, or instrument for measuring N. P. D., or declination. The observer is released from the necessity of reading a divided circle, and the position of his instrument at the moment his star is bisected by the declination wire, is, by a single touch, engraved on metal, and stereotyped, to be read and examined when convenience may permit. On the swiftest moving stars, *ten bisections* are readily accomplished and engraved in the space of a single minute of time, and at a maximum hour angle of only thirty seconds of time. These records are now made on a circumference whose diameter is nearly twelve feet, and finally read up by a micrometer of as great perfection as can be applied to the measurement of any minute distances. The instrument used thus far is a transit by Dollond, the property of the United States Coast Survey, and furnished by the Superintendent of that work. It is of old construction, about five feet focus; and although the definition of its object-glass is satisfactory, yet the optical power is low, and a bisection by it is far inferior to one made with a powerful object-glass. The new machinery attached to this transit, to convert it into a declinometer, was made in the observatory by my assistant and myself, and is, of course, comparatively rough. The micrometer was made in this city, and although of workmanship highly creditable to the artist, yet, as it is the first ever constructed on this plan, it has been found comparatively defective, and quite incapable of detecting with certainty the minute quantities which have been presented for its examination. Perhaps no micrometer has ever been submitted to such severe tests.

Thus far in the application of the new methods, my examinations

have been confined to zones not exceeding twenty-five degrees in width. There is no difficulty, however, in extending these researches through the entire heavens, and comprehending on the same night the entire sweep of the meridian from north to south.

In case a known catalogue is under review, the amount of work done during the night will depend solely on the rapidity with which the finders of the telescope can be set. If we allow for each star three minutes, (which, with an assistant to set, has been found sufficient,) we have without difficulty two hundred observations on twenty different objects within the hour, and for a night's work of five hours, one thousand wires or observations recorded on one hundred stars or other objects. If, however, the work done is independent of any catalogue, and we are sweeping the heavens in zones, there is no difficulty in recording both right ascension and declination on single wires just as rapidly as the stars present themselves, even up to three hundred stars per hour of time. This has actually been done. For the purpose, therefore, of cataloguing the heavens, the new methods offer advantages of the highest importance.

We now present some of the results tending to demonstrate the degree of precision already reached in the determination of the differences of declination. As the whole subject was entirely new, no advantage could be gained from the experience of other observatories, and hence the difficulties which have been met were encountered under the most unfavorable circumstances. Having, however, implicit confidence in the great principles involved in the new machinery, I never doubted for a moment that the discrepancies which arose would finally be traced to mechanical defects, or to accidental and unanticipated causes.

My attention has been exclusively directed to this single point: *within what limits of error could the new apparatus repeat its own work on different nights on stars whose difference of declination varied from a second or two of arc up to 25° or 30° ?*

To convert the records into degrees, minutes, and seconds, presents no serious difficulty, and has, therefore, not as yet occupied my attention further than to demonstrate with certainty its practicability.

In my very earliest observations with *ten* declination wires, more than two and a half years since, a simple inspection of the record in the shape of ten delicate wedge-shaped dots on metal, with a powerful microscope, demonstrated at once the perfection with which these records were made within the narrow space occupied by these ten dots. The wires were as nearly parallel and equidistant as we could place them. Yet the small inequalities of distance were always measured with a precision only limited by the power of bisection under the circumstances existing during the observation. When the weather was tranquil and the stars steady, the most admirably accordant results were reached: on the contrary, when the stars were dancing or ill-defined, discrepancies were recorded doubtless due to errors of bisection. It is quite unnecessary to present the evidence of accurate movement within the above narrow limits, inasmuch as the wider range of observation will include the more restricted.

When, on a comparison of the work of two different nights, the discrepancies were reduced to the fraction of a second of arc, it became

manifest that the micrometer was (as built) incapable of measuring with certainty such minute quantities. I had neither time nor means to build a new and more perfect instrument; and finding the micrometer reliable for half a dozen revolutions of the micrometer screw, a method of intercomparison of the work of two different nights occurred to me, which, with my defective micrometer, would test in the most absolute manner the powers of the new machinery. This was as follows, viz:

The stars of the catalogue were observed during one night on the *odd wires*, 1, 3, 5, 7, and 9, leaving the spaces blank on the engraved record, which corresponded to the even wires, 2, 4, 6, 8, and 10. Everything remaining untouched, on the following clear night the same stars were observed on these even wires, and thus a decade of dots was recorded, of which five were engraved on one night, and five others on the following one.

These records thus intermingled and interlocked, were now easily read by the micrometer; and falling, as they did, within the limits of reliable performance of the micrometer, the capacity of the instrument to repeat itself on different nights was tested in the most absolute manner, no matter if the stars observed comprehended a zone of even 25° or 30° . It is proper to remark that in all these observations I was assisted by Mrs. Mitchel, the stars being taken by us alternately; the reading up was done principally by herself, while the duty of recording fell to me. In this way the results reached would be independent of any personal idiosyncrasy, while the readings being made by one person and recorded by another, no bias could possibly be given to the person reading.

In our first experiment of interlocking observations, forty-eight hours elapsed before it became possible to remove the metal plate from the pier, during which interval of time there were constant changes in the atmosphere, with storms of rain and wind. It was therefore with no small anxiety that, on closing the observations, the microscope was turned upon the decade of dots, the work of two nights, at intervals of forty-eight hours. The examination was in the highest degree satisfactory. The dots were placed with a precision and beauty perfectly astonishing, and no eye, thus far, with the microscope itself, has been able to mark the difference between a decade of dots struck on two different nights, and one struck all on the same night. It did not require the micrometer screw to decide the question as to whether the instrument had repeated itself on the two different nights. This was obvious from a mere inspection of the dots by the microscope. In two instances on the extreme stars there was a slight deviation from the uniformity of the placing of the dots. I suspected this to be owing to the action of the wires attached to the arm and conducting the current from the battery through the electro-magnet. Ample length was given to the wire, but there yet remained in it a sufficient stiffness to affect the place of the arm in its extreme positions, by a minute amount. This was fully demonstrated by experiment on the following night. A star was brought to bisection on a wire, and while thus located the conducting wires were gently touched by the hand of the observer and the instrument was seen to yield to every touch. A source of error was thus detected, of a minute character indeed, but of vast importance

where tenths of seconds of arc were the quantities under examination. The admirable agreement now found to exist uniformly between the work of different nights encouraged me to go back and remeasure, with greater care, the old work still remaining engraved on the plate. By using a mean of two or three measures the observations were brought to the most surprising coincidence. I did not attempt a remeasure of all the observations, but contented myself with a rigid examination of a single pair of N. A. stars, among whose observed differences of declination average discrepancies existed. I copy the final results, remarking simply that the observations were made between the 26th May and the 30th June inclusive.

The following are the decimals of a revolution of the micrometer screw in the ten observations :

					Seconds of arc.
α Coronae to ϵ Bootis	.6836	Diff. from mean	.0017	=	0.068
" "	.6609	" "	.0210		0.840
" "	.6891	" "	.0072		0.286
" "	.6883	" "	.0064		0.256
" "	.6906	" "	.0085		0.340
" "	.6757	" "	.0052		0.208
" "	.6699	" "	.0120		0.480
" "	.6886	" "	.0067		0.268
" "	.6905	" "	.0086		0.344
" "	.6784	" "	.0054		0.220
	<u>.6819</u>	" "			<u>0.340</u>
					Probable error, 0.250

					Seconds.
α Cor. to ϵ Bootis, Greenwich Obs., 1840	.....				0.05
" "	" "	" "	" "		1.61
" "	" "	" "	" "		1.64
" "	" "	" "	" "		1.02
" "	" "	" "	" "		1.25
" "	" "	" "	" "		2.67
" "	" "	" "	" "		1.39
" "	" "	" "	" "		0.81
" "	" "	" "	" "		2.05
" "	" "	" "	" "		2.52

1.401 Prob. error, 1".3

I shall now present a few measures of the sun's diameter, in which it must be observed that only relative quantities are obtained. Taking the N. A. as accurate on any one day of those indicated in the observations, we found the power of the new apparatus to trace the apparent changes in the sun's diameter. This is not yet absolute work.

Observations of the $\odot$ diameter at the Cincinnati Observatory, Sept., 1850.

	Obs.	Comp.	Diff.
September 3	1906.68	1906.40	+ 0.28
4	1907.40	1906.80	+ 0.60

	Obs.	Comp.	Diff.
September 5	1906.82	1907.40	- 0.58
6	1907.62	1907.80	- 0.18
7	1906.73	1908.40	- 1.67
9	1910.74	1909.40	+ 1.34
12	1911.58	1910.80	+ 0.78
13	1910.17	1911.40	- 1.23
16	1912.44	1913.00	- 0.56
17	1912.65	1913.40	- 0.75
19	1914.74	1914.60	+ 0.14
20	1916.00	1915.20	+ 0.80
21	1916.62	1915.60	+ 1.02
1851.			
May 15	1900.10	1900.02	+ 0.08
22	1897.80	1897.60	+ 0.20
24	1897.46	1896.80	- 0.66
26	1896.07	1896.20	- 0.13

The work in 1850 was measured with the defective micrometer, and I attribute the increased discrepancies to this cause, rather than to any inaccuracy in the observations or records.

On the application of the principle already explained, of intermingling the observations of two different nights, most of the large discrepancies which had for a long time annoyed me, and which I felt were due to imperfections in the micrometer (but which I had not hitherto been able to demonstrate,) all disappeared, and the results have since exhibited the most surprising harmony. I shall present only a few specimens of the work done, as a more full and elaborate report will be made hereafter.

Observations of June 16 and 17, 1851.

		16th.	17th.	Diff.	Sec'ds.
Observer, M. ε Bootis to B. A. C. 4969 L...		6060	6064	0004	0.016
"	L. α Coronae....	6508	6420	0088	0.352
"	M. 4706.....	3397	3288	0109	0.336
"	M. α Bootis.....	8877	8687	0190	0.760
"	M. 4933.....	8882	8663	0199	0.796
"	L. 5120.....	1430	1268	0162	0.648
"	L. α Serp.....	2245	2252	0007	0.028
					0.418
M. ε Bootis to 4969 L.....		.6060	.6064	0004	0.016
4969 " α Cor. L.....		.0448	.0351	0097	0.338
α Cor. " 4706 M.....		.6889	.6873	0016	0.064
4706 " α Bootis M.....		.5480	.5399	0081	0.324
α Bootis " 4933 L.....		.0051	.9946	0095	0.380
4933 " 5120 L.....		.2553	.2605	0052	0.208
5120 " α Serp. M.....		.0815	.0992	0177	0.738
					0.302

I present one more specimen of the same kind of work, with some slight additional security for accuracy, simply remarking that here again the stars were observed by L. and M. without any specific order:

				Diff.	Seconds.
B. A. C. No. 6084, to	6323	5820	5896	0076	0.304
"	"	ε Bootis	1335	1319	0016
"	"	α Coronae	1407	1399	0008
"	"	6657	1662	1662	0000
"	"	6106	6430	6614	0234
"	"	6589	7340	7380	0040
"	"	α Bootis	1530	1670	0140
"	"	6110	1669	1699	0030
"	"	α Herculis	9980	0046	0066
"	"	α Serpentis	0540	0576	0036
					10)2.560
					2)0.256
					0.1280

Here it will be seen there is no accumulation of error due to the increased distance between the stars observed. This will also become more evident by examining the observations of intervals between wide stars on the preceding nights already reported.

I am now satisfied that the errors which yet remain may be diminished one-half by the use of ten instead of five declination wires; and, finally, that all work for difference of declination between stars may be accomplished with an accuracy equal to the best micrometer work, when the stars are but a few seconds apart.

The best work done in the world, (so far as I know,) has been accomplished in the Imperial Russian Observatory at Pulkova, and is reported by M. Struve in his great work on that institution. By the greatest refinement of art and skill on a few stars, the accordance between the determinations of different nights has been brought to within a limit of probable error of two-tenths of one second of arc. It will be seen by examining the results reported, that the new method, in the very infancy of its application, with defective instruments, low optical power, and with every possible disadvantage to contend with, has already rivalled in accuracy the best work ever done. Indeed, the last work reported greatly surpasses the Pulkova work in accuracy, as the average error on ten differences of declination amounts to no more than twenty-five hundredths of one second of arc, while the average error in the Pulkova observations amounts (on differences of declination) to forty-hundredths of one second of arc.

But the old methods have already been pushed to their ultimate limit of attainable precision. Of this, I think any one will be convinced who will read M. Struve's admirable history of the Pulkova Observatory and its instruments. On the contrary, in the new method, almost nothing has been done. Any one who has used telescopes of low power and those of great power, need not be reminded of the extraordinary advantage which high optical power and good definition gives in bisecting a star.

In the great refractor of the Cincinnati Observatory, ϵ Bootis is divided into two beautiful stars, some two seconds of arc asunder, each round and sharp; while in the small instrument used in the foregoing observations, the same star appears as a single object, a large mass of light. In case it were possible to employ the optical power of the great refractor, the most astonishing increase of accuracy might be anticipated. If such an object-glass were mounted as a transit, the records would then be made very conveniently on the circumference of a circle thirty feet in diameter, and a second of arc would occupy a space nearly three-fold greater than that now in use by me, and four-fold greater than is elsewhere employed (so far as I know) in the world. Again, thus far, it must be remembered that the preceding results are the means of *five wire observations*. There is no difficulty in increasing the number of wires to ten or even fifteen, should it be desirable. In short, the new method is capable of almost indefinite expansion and increased accuracy—1. By increase of optical power. 2. By perfecting the mechanical arrangements. 3. By increasing the radius of the recording circle. 4. By increasing the number of observations, or the number of declination wires.

The new method also involves a principle of wonderful value in the delicate work to which it must be applied. I mean the power of stereotyping the positions of the instrument, so that the observations may be scrutinized at leisure, and be read and re-read until the error of reading up shall be reduced to an insensible quantity: this cannot be done in the old method.

What, then, may we not anticipate from the application of this new machinery, under favorable circumstances, to the examination of the heavens? If Struve dared pronounce his instrument competent to the determination of parallax, proper motion, &c., with results discrepant to two-tenths of one second, then indeed has the new machinery converted a small inferior transit into an instrument competent to cope with these grand mechanical questions.

Apply it, then, to instruments of perfect construction, of high optical power, with equal advantages of high mechanical perfection, with a full ten-wire diaphragm, interlock the observations until the power of the micrometer is fully and positively determined, and then who will dare to anticipate the results which may be reached by such a combination of science and mechanical power? Motions which have hitherto required centuries for their detection and measurement, variations in the proper motions of the fixed stars, which have only been suspected, parallax annual and systematic—even the position of the double stars themselves—may not all these, to say nothing of aberration, nutation, precession, fall fully within the range of rapid and positive research?

With the delicate and powerful machinery for determining R. A., on which no less than twenty-five wires are successfully employed, combined with this no less powerful means of measuring difference of declination, may we not hope that even in the lifetime of a single observer, some of the dark problems of the heavens which now defy our utmost efforts may be resolved and yield up their long and deeply concealed mysteries? My only regret is, that I do not possess the means to exe-

cute an immediate application of these new methods to the resolution of these high and profound problems.

Very respectfully, your obedient servant,

O. M. MITCHEL.

Professor A. D. BACHE,

Superintendent of the Coast Survey.

APPENDIX No. 10.

Extracts from the report of Professor Agassiz to the Superintendent of the Coast Survey, on the examination of the Florida reefs, keys, and coast.

CAMBRIDGE, August, 1851.

SIR: The following report of the examination made by me of the Florida reefs, keys, and coast, is prepared in compliance with your request:

Topography of Florida.

To form a correct idea of the Florida reefs, it is of paramount importance to keep in mind the topographical features of the whole country. The peninsula of Florida projects between the Gulf of Mexico and the Atlantic, from the 30th degree of northern latitude, nearly to the 24th, as a broad, flat, low promontory, which has generally been considered a continuation of the low lands of the southern States. But, as we shall see hereafter, this is not the case, or, at least, not with respect to the southern extremity of the peninsula, which consists of the same formations as the reef itself. Again, in a physical point of view, Florida is not limited to those tracts of land, forming the peninsula, which rise above the level of the sea, for the extensive shoals along its southern extremity, between the main land and the keys and reefs, as well as those extending to the west as far as the Tortugas, whence they stretch along the western coast, in fact belong to it, and are intimately connected with it, by their physical character. There is a similar tract of flats along the eastern shore, but it is not so extensive as on the southern and western shores, nor does it partake as largely of the peculiar character of the peninsula, being chiefly formed of the alluvial sand, drifted ashore by the waters of the Atlantic.

We shall have occasion, however, to show hereafter that the narrow longitudinal islands, which extend close to the main land almost for the whole length of the eastern shore, are probably a direct continuation of the keys, covered with drifted sand.* This is certainly the case with the range of keys extending from the main land to Cape Florida, which limits to the east the bay of Miami, their formation being of coral rock, but covered by silicious drift-sand.

As to the southernmost extremity of the main land proper, it is very difficult to determine its outlines, as it consists of innumerable islands,

* A direct investigation of this point, which did not come within the limits of my survey, would be of considerable practical importance, inasmuch as it may lead to the discovery of a basis of coral rock, affording a far more solid foundation for the construction of the light-houses wanted along that coast than the loose shore detritus.

sometimes separated by narrow channels, and sometimes assuming the character of real islands only at high water, being mostly connected with the main land by very shallow flats. This is especially the case along the southwestern extremity of the peninsula. The outline of the southern shore, however, between Cape Florida and Cape Sable, is better defined—presenting, in almost unbroken continuity, steep bluffs of the same coral limestone which forms the bottom of the everglades, and may be traced, without interruption, along the Miami from the sea-shore to the everglades.

South of the main land, between it and the range of keys, there are extensive flats, which, even at high water, are but slightly covered, and which the retreat of the tide lays bare, leaving only narrow and shallow channels between the dry flats, with occasional depressions of greater depth. These mud flats extend not only between the main land and the keys as far as Cape Sable, but may be traced to the north along the western shores of the continent, and to the west along the northern shores of the keys, not only as far as Key West and the Marquesas, but even to the Tortugas.

There is, however, this remark to be made—that to the west the mud flats become covered, by degrees, with deeper and deeper water; or, in other words, that these low grounds, extending between the main land and the main range of keys, dip slightly to the west, being gradually lost in the shoals extending north of the Marquesas and the Tortugas, along the western shore of the peninsula. These flats are interspersed with innumerable low islands, known in the country by the generic appellation of the Mangrove islands, respecting which we shall give further details hereafter.

The shoals between Cape Sable, Cape Florida, and the main range of keys, are literally studded with these Mangrove islands. Sometimes they are distributed without apparent regularity; sometimes, as to the north of Key Largo, they form a continuous range between the main land and the keys. They are also very numerous along the main keys, or at least along that side of them which is turned towards the most extensive mud flats. Sometimes these Mangrove islands form little archipelagoes of innumerable small islets, so intimately interwoven, and separated by such narrow and shallow channels, as to be almost impenetrable. Such archipelagoes occur chiefly to the north of Bahia Honda and the Pine islands, as well as to the northwest of Key West. The luxuriant vegetation which rises from these low islands, consisting chiefly of mangroves, gives them a very peculiar appearance. We shall have occasion to return to this subject, when we attempt to explain the formation of the different islands connected with the Florida reef and the main land. The whole tract between Cape Sable and the keys, east of Bahia Honda, as far as Cape Florida, or at least as far as Soldier key, is so shoal that it will forever remain inaccessible, except to very small vessels.

The keys consist of an extensive range of low islands, rising but a few feet, perhaps from six to eight or ten, or at the utmost to twelve or thirteen feet, above the level of the sea. They begin to the north of Cape Florida, where they converge towards the main land, extending in the form of a flat crescent in a southwesterly direction, gradually

receding from the main land until, opposite Cape Sable, they have so far retreated as to be separated from it by a shallow sheet of water forty miles wide. Farther to the west they project in a more westerly course, with occasional interruptions, as far as the Tortugas, which form the most western group. They consist either of accumulated dead corals, of coral rocks, or of coral sand, cemented together with more or less compactness. Their form varies, but is usually elongated and narrow, their greatest longitudinal extent following the direction of the main range, except in the group of the Pine islands, where their course is almost at right-angles with the main range—a circumstance which we shall attempt hereafter to explain.

Most of these islands are small, the largest of them, such as Key West and Key Largo, not exceeding ten or fifteen miles in length; others only two or three, and many scarcely a mile. Their width varies from a quarter to a third or half a mile, the largest barely measuring a mile across; but whatever the difference in their size, they all agree in one respect—that their steepest shore is turned towards the Gulf Stream, while their more gradual slope inclines towards the mud flats which they encircle.

This is a point which it is important to notice, as it will assist us in our comparison between the keys and the shore bluffs of the main land, as well as with the outer reef and the reefs of other seas, in all of which we find that the seaward shore is steeper than that turned towards the main land, or, in the case of circular reefs enclosing basins (atolls,) than that which borders the lagoon.

The reef proper extends parallel to the main range of keys, for a few miles south or southeast of it, following the same curve, and never receding many miles from it. The distance between the reef and the main range of keys varies usually from six to two or three miles, the widest separation being south of Key West and east of the Ragged keys, where the space is about seven miles. Between this reef, upon which a few small keys rise at distant intervals, and the main range of keys already described, there is a broad, navigable channel, extending the whole length of the reef from the Marquesas to Cape Florida, varying in depth from three to six and seven fathoms, and, except off Looe key, where the passage is not more than fourteen feet deep at low water, averaging from three to four fathoms.

Farther east the average depth is again the same as at Looe key; but it becomes gradually more and more shoal towards the east, measuring usually about two fathoms, or even less, to the east of Long key and Key Largo, but deepening again somewhat towards Cape Florida, where the reef converges towards the main keys and the main land. Protected by the outer reef, this channel affords a very safe navigation to vessels of medium size, and would allow a secure anchorage almost everywhere throughout the whole length of the reef, were the numerous deep channels which intersect the outer reef well known to navigators and marked by a regular system of signals. As it is, however, the reef seems to present an unbroken range of most dangerous shoal grounds, upon which thousands of vessels, as well as millions of property, have already been wrecked. These facts have a stronger claim upon the attention of the government, since there are, as already re-

marked, numerous passages across the reef which might enable even the largest vessels to find shelter and safe anchorage behind this threatening shallow barrier. * * * * *

The reef proper, as we have remarked above, runs almost parallel to the main range of keys from Cape Florida to the western extremity of the Marquesas, where it is lost in the deep. It follows in its whole extent the same curve as the keys, encircling to the seaward the ship channel already mentioned. This is properly the region of living corals.

Throughout its whole range it does not reach the surface of the sea, except in a few points where it comes almost within the level of low-water-mark, giving rise to heavy breakers, such as Carysfort, Alligator reef, Tennessee reef, and a few other shoals of less extent, but perhaps not less dangerous. In a few localities fragments of dead coral and coral sand begin to accumulate upon the edges of the reef, forming small keys, which vary in form and position according to the influence of gales blowing from different directions—sometimes in the direction of the Gulf Stream from southwest to northeast, but more frequently in the opposite direction, the prevailing winds blowing from the northeast. Such are Sombrero key, Looe key, the Sambos, and Sand key. Here and there are isolated coral boulders, which present projecting masses above water, such as the Dry Rocks, west of Sand key; Pelican reef, east of it; with many others, more isolated. Though continuous, the outer reef is, however, not so uniform as not to present many broad passages over its crest, dividing it, as it were, into many submarine elongated hillocks, similar in form to the main keys, but not rising above water, and in which the depressions alluded to correspond to the channels intersecting the keys. These broad passages leading into the ship channel, which may be available as entrances into the safe anchorage within the reef, are chiefly the inlet in front of Key Largo and to the west of Carysfort reef, with nine feet of water; a passage between French reef and Pickle reef, with ten feet; another between Conch reef and Crocus reef, also with ten feet; another between Crocus reef and Alligator reef, with two fathoms; another between Alligator reef and Tennessee reef, with two fathoms and a half; and a sixth to the west of Tennessee reef, varying in depth from two and a half to three fathoms.

The remark which has been made respecting the mud flats and their gradual deepening from east to west, applies equally to the general features of the main reef, as well as to the intervening channel. To the eastward the channel is shallower, the ground around the keys and reef becomes shoaler, and there is a gradual dip towards the west, which makes the connexion less marked between the keys west of Key West, in the large groups of the so-called Mangrove islands, and the Marquesas, beyond which there is even an extensive interruption in the succession of the keys before we reach the Tortugas. These last, however, as well as the bank west of these keys, belong none the less to the main range of keys, from which they are only separated by a more extensive and deeper depression. West of Sand key the reef itself becomes gradually less elevated, until it is finally lost where the

ship channel, south of the Marquesas, expands into the broad depression, separating that group of keys and shoals from the Tortugas.

In order to understand fully not only the topography, but also the mode of formation of all these keys and reefs, it must be remembered that the rising reefs, which form more or less continuous walls, reaching at unequal heights nearly to the surface, or above the level of the waters, are only a particular modification of those formations growing upon coral grounds under special circumstances. It has been ascertained, whenever similar investigations have been made, that living corals do not occur in depths exceeding twenty fathoms, that the reef-building species prosper from a depth of about twelve fathoms nearly to the surface, and that different species follow each other at successive heights. Now, if we keep in mind these facts, we shall see that all the coral-bound islands of the West Indies, as well as of the main land of Central America, constitute an extensive coral field, divided by broad, deep channels, over which the coral reefs extend, with different features, according to the depths in which they occur and the changes which their own growth has gradually introduced upon the localities where they are found, influenced and modified to some extent also by the direction of the prevailing currents and the action of the tides.

The formation of the main range of keys in their primitive condition as a reef—for, as we shall see hereafter, they have been a sub-marine reef before they rose as islands above the level of the ocean—the formation of this range, we repeat, at gradually greater distances from the main land, as we follow their course from east to west, has been simply owing to the depth of the bottom from which the reef has risen. It has followed the line of ten or twelve fathoms depth; and if there is so wide an interruption between the Marquesas and the Tortugas, it is because the ground is deeper over that space. Again, if the Pine islands have a northwesterly direction, while the main range runs more from east to west, it is no doubt because the body of water emptying from the northern part of the gulf, along the western shores of the peninsula, has, for a time, run chiefly over that field, while the tract of mud flats between the keys and the main land was filling prior to the formation of the outer reef, the rising of which, as an external barrier, must have modified greatly the course of the currents north of the keys at a later period, leaving between them only a few narrow but navigable channels, such as exist now between the Marquesas and the Mangrove islands, between these and Key West, and between the Pine islands and the group of Bahia Honda.

* * * * *

We would only add that the absence of corals along the western shore of the peninsula, at present, is probably owing to the character which that shore has assumed in the progress of time, for the peninsula itself has once been a reef, at least as far as the 28th degree of north latitude, as is shown by the investigation of the everglades, and by the examination of the rocks at St. Augustine.

This latitude is the natural northern limit of the formation of coral reefs, as also of the extensive growth of stony corals; though on the southern shores of the North American continent, these formations seem to have extended far beyond their usual bounds, probably under the in-

fluence of the high temperature of the Gulf Stream, for not only do the narrow, longitudinal islands which extend along the eastern shore, and their direct connexion with the small keys north of Cape Florida, indicate their coralline origin, but we have even under the 32d degree of north latitude extensive coral formations at the Bermudas still flourishing in the present day. If the growth of corals has been stopped along the eastern shore, it must be ascribed to the invasion of drift sand, which extends over the everglades, as well as along the eastern shores as far south as the Miami, Key Biscayne, and the bay of the Miami.

* * * * *

Mode of formation of the reef.

The reefs of Florida as they have been described in the foregoing sketch of the topography of that State, and, indeed, the separate parts of each of these reefs, in their extensive range from northeast to southwest, present such varieties as will afford, when judiciously combined, a complete history of the whole process of their formation.

Here we have groups of living corals, beginning to expand at considerable depth, and forming isolated, disconnected patches, the first rudiments, as it were, of an extensive new reef. There we have a continuous range of similar corals in unbroken continuity for miles, or even hundreds of miles, rising at unequal heights nearly to the surface.

Here and there a few heads or large patches, or even extensive flats of corals, reach the level of low-water mark, and may occasionally be seen above the surface of the waters, when the sea is more agitated than by the simple action of the tides. In other places coral sands or loose fragments of corals, larger or smaller boulders, detached from lower parts of the living reef, are thrown upon its dying summits, and thus form the first accumulation of solid materials, rising permanently above low-water mark; collected sometimes in such quantities and at such heights as to remain dry, stretching their naked heads above high water.

In other places these accumulations of loose, dead materials have entirely covered the once living corals, as far as the eye can reach into the depth of the ocean: no sign of life is left, except perhaps here and there an isolated bunch of some of those species of corals which naturally grow scattered, or of those other organisms which congregate around or upon coral reefs; but the increase of the reef by the natural growth of the reef-building corals is at an end. Again, in other places, by the further accumulation of such loose materials, and the peculiar mode of aggregation which results from the action of the sea upon them, and which will be more fully explained hereafter, extensive islands are formed, ranging in the direction of the main land, which support them. Elsewhere we may find the whole extent of the reef thus covered, which, after a still more protracted accumulation, perhaps becomes united with some continental shore.

Now it must be obvious, that from a comparison of so many separate stages of the growth of a coral reef, a correct insight may be obtained into the process of its formation; and, indeed, in thus alluding to the different localities which came under our own observation, we have

already given a general history of its progress, which we now proceed to illustrate more in detail.

We would, however, first remark, that the extraordinary varieties which exist in the natural condition of different parts of the same reef, or of different reefs, when compared with each other, fully explain the discrepancies between the reports which have been obtained, respecting the reefs of Florida, prior to our investigations.

It had been stated that the reefs consisted solely of living corals; and, indeed, this report is true of the outer reef, which is called by all the inhabitants of Florida "*the reef*" *par excellence*, and is unfounded only with regard to those few islands which rise above the surface of the sea at Sand key and the Sambos. Others, who had noticed only the larger accumulations of coral fragments which occur on the shores of some of the islands forming part of the Florida reef, had reported the islands to be formed of coral rocks; while some who had, perhaps, observed the extensive excavations made around Key West, have told us only of the existence of oolitic and compact rocks, almost destitute of corals or other remains of animal life; and from still other localities comes the opinion, that the rocks consist of nothing but more or less disintegrated shells, cemented together. * * * *

Animal Life.

* * * * *

This fullness and variety of animal life is particularly obvious within the boundaries of coral fields, the natural limits assigned to the growth of these animals being those in which animals of other classes range in greater profusion, and the coral reefs themselves also affording very favorable circumstances for the display of numerous living forms. Hence the extraordinary assemblage of all classes of animals upon the reef, where, besides those particular kinds of corals which contribute largely to its formation, we find upon it, or on the foundation from which it rises, a great variety of other corals, which, though too insignificant in size to take a conspicuous part in building up these extensive accumulations of organic lime-rock, add none the less their small share in the work, contributing especially to fill up the vacant spaces left by the more rapid and durable growth of the larger kinds. They are to the giants of the reef what the more slender parts are to the lords of the forest, adding the elegance and delicacy of slighter forms to the strength, power, and durability of their loftier companions.

But besides the stony corals, we find in the reef a great variety of soft polyps, either attached to the surface of dead corals, dead shells, or of the naked rock, or boring into the coral sand and mud.

* * * * *

Such are different species of Arca, the date-fish among the Mollusca, and many worms, especially Serpula among articulates, the agency of which in the formation of the keys will be described hereafter. All these animals and plants contribute, more or less, to augment the mass of solid materials which is accumulating upon the reef, and increase its size. Not only are the hard parts of shells, echinoderms, worms, or their

broken fragments, heaped among the detritus of the corals, but occasionally even the bones of fishes and turtles, which are very numerous along the reef, may be found in the coral formations.

The decaying soft parts of all these animals undoubtedly have their influence upon the chemical process, by which the limestone particles of their solid frame are cemented together, in the formation of compact rocks. Upon this point we may expect further information from Professor Horsford, who is now submitting to chemical analysis all the variety of rocks and the solid stems of the different corals obtained in Florida. Respecting the relations of the solid and soft parts of the living coral, and their mode of growth, we would refer to a paper of ours now in press, to appear in the next volume of the *Smithsonian Contributions to Knowledge*. * * * * *

The Keys.

* * * * *

We see everywhere that the larger boulders and the coarser fragments have been the first to find a resting-place upon the dead reef; the minuter particles and coral sand, which are periodically washed away from its crest during heavy gales, never accumulating upon it till large boulders and more solid materials have collected to such an extent as to form sufficient protection for the more movable, looser fragments. This fact is beautifully illustrated by an accurate survey of Sand key, where a wide field of large boulders is partially laid bare at low water, presenting the appearance of an extensive key, with a low hill of minute materials, the product of some heavy gale, heaped upon the summit, against which the sea plays without disturbing it materially, even at high water, when it leaves in sight only a nucleus, as it were, for a greater accumulation of such loose materials which may in time cover the whole surface of the larger boulders. We have here in reality the same phenomenon which is observed upon all beaches, where larger materials have first accumulated on a shoal shore, being followed, in the course of time, by more minute fragments which have found a resting-place upon levels where the sea was powerless to increase the collection of coarser matter. In attempting to understand these formations, it must be remembered that the accumulation of the larger materials, collected at a certain level, may modify the action of the water at a subsequent period, thus producing a combination of substances, heaped unconformably upon each other. This is, in reality, the case throughout the whole main range of keys, which have been raised to their present level by the action of the tides and gales for ages past, the fragments of which they are composed having been thrown up at different periods, and overlying each other in such a manner as to present the same irregularity which is found in all drift stratification. Layers upon layers are seen resting unconformably, dipping in different directions so as to present all the modifications which may be observed in torrential stratification, each layer following, with more or less regularity, the course of the flood under which it has been accumulated.

* * * * *

By a process, not yet fully understood, but to which we shall return hereafter, these loose collections are gradually cemented into solid rock, presenting the most diversified appearance, according to the substances of which it is composed. Then we find a coarse breccia, consisting of larger fragments of corals and shells, enclosing sometimes coral boulders; and this is the sort of rock which generally overlies the immediate surface of that portion of the keys which has been formed by the progress of the reef, growing *in situ*. Such rock was seen among the foundations of the new light-house at Sand key, where the large boulders are very numerous, and seem almost as fresh as if they had been lying on the spot but for a few years. It may be, indeed, that during the hurricane of 1846, the whole cap of the reef was renewed at that spot.

* * * * *

A careful survey of the character of the rocks in the keys affords satisfactory evidence that they have been formed at whatever height they may rise, by the same action which is now going on upon the reef—that is, by the accumulation of loose materials above the water-level. That part of the keys which rises above the level of the water is, therefore, a sub-aerial and not a submarine accumulation of floating matter, thrown above high-water mark by the tempestuous action of the water. We insist upon the fact, that the keys furnish in themselves, by the internal structure of their rock, the fullest evidence that they have been formed above high-water mark by the action of gales and hurricanes, instead of having grown as a reef up to the water-level, and been subsequently raised to their present height. The evidence of this statement rests upon certain facts obtained from observation of the reef itself, at Sand key and the Sambos.

* * * * *

Let us now return from this digression to the consideration of the keys themselves, under the different aspects which they present. We find, then, that some have more abrupt shores, being, as it were, narrow shelves with ragged edges, rising without a beach from deep water; these are undoubtedly such as were formed upon the narrowest part of the old reef. Others spread more uniformly, having an extensive beach, and dip gradually under the sea, presenting a gentle, submarine slope, covered with coral sand and mud; these were, no doubt, formed upon the broader parts of the reef, where it descends gently on both sides. Again, we find those which, though resembling the last in general appearance, may have more abrupt shores, owing to the denudation of parts of their earliest deposits. Occasionally we see that more recent layers have filled again such worn places, thus presenting, on a miniature scale, among the latest formations among layers which belong altogether to the present geological age, all the diversity of unconformable deposits which occur in former geological periods.

Coral Reefs.

After examining a growing coral reef, so full of life, so fresh in appearance, so free from heterogeneous materials, in which the corals adhere so firmly to the ground, or if they rise near the surface seem to

defy the violence of the ocean, standing uninjured amid the heaviest breakers, an observer cannot but wonder why, in the next reef, the summit of which begins to rise above the level of the water, the scene is so completely changed. Huge fragments of corals, large stems, broken at their base, gigantic boulders, like hemispheres of *Porites*, and *Macandrina*, lie scattered about in the greatest confusion—flung pell-mell among the fragments of more delicate forms, and heaped upon those vigorous madrepores which reach the surface of the sea.

The question at once arises, how is it that even the stoutest corals, resting with broad base upon the ground, and doubly secure from their spreading proportions, become so easily a prey to the action of the same sea which they met shortly before with such effectual resistance? The solution of this enigma is to be found in the mode of growth of the corals themselves. Living in communities, death begins first at the base or centre of the group, while the surface or tips still continue to grow, so that it resembles a dying centennial tree, rotten at the heart, but still apparently green and flourishing without, till the first heavy gale of wind snaps the hollow trunk, and betrays its decay. Again, innumerable boring animals establish themselves in the lifeless stem, piercing holes in all directions into its interior, like so many augers, dissolving its solid connexion with the ground, and even penetrating far into the living portion of these compact communities. The number of these boring animals is quite incredible, and they belong to different families of the animal kingdom: among the most active and powerful we would mention the date-fish, *Lithodomus*, several *Saxicava*, *Petricola*, *Arca*, and many worms, of which the *Serpula* is the largest and most destructive, inasmuch as it extends constantly through the living part of the coral stems, especially in *Macandrina*.

On the loose basis of a *Macandrina*, measuring less than two feet in diameter, we have counted not less than fifty holes of the date-fish—some large enough to admit a finger—besides hundreds of small holes made by worms.

But however efficient these boring animals may be in preparing the coral stems for decay, there is yet another agent, perhaps still more destructive. We allude to the minute boring-sponges, which penetrate them in all directions, until they appear at last completely rotten throughout.

* * * * *

Ship Channel.

The broad channel extending the whole range of the reef, between the main keys and the outer reef, is rather uniform, having the same width throughout, with the exceptions of those few places where the reef widens, or the mud flats from the keys encroach upon it. Its narrowest passages are between Looe key and the Pine islands, between Pickle and French reefs, and between Key Rodrigues and Tavernier. It is also somewhat narrowed between Alligator reef and Indian key, and is widest off Key West. Its depth varies also slightly, being shoaler in its eastern range than to the west. The shallowest part is between Pickle reef and Key Rodriguez, and between Looe key and Pine islands.

But if we do not take into account those spots where the depth is reduced from local circumstances, we may say, that, as a whole, the ship channel begins to the east, with a depth of about two fathoms between Fowey rocks and Soldier key, increasing gradually thence, until it reaches three fathoms between Pacific reef and Old Rhodes, then becomes again slightly reduced between Carysfort reef and Key Largo; after which, with the exception of the shoals between Pickle reef and Key Rodriguez, it deepens again to three, four, five, or even six fathoms, until, between Looe key and Pine islands, it shoals once more to fourteen feet. Farther on, it increases again to five, six, and seven fathoms, the average depth between Key West and the reef being five or six fathoms; and still beyond, more towards the west, sinks to eight, nine, and ten fathoms between the western extremity of the Marquesas and the western end of the reef, where it spreads into the great depression separating the Tortugas from the Marquesas. The character of the bottom varies in different parts, as do also the living beings which it supports. Where it is the most shoal, as between Fowey rocks, Triumph reef, and Long reef, on one side, and Soldier key and the Ragged keys on the other, the bottom consists of coral sand, overgrown with what is called the country *grass*; that is to say, a variety of the limestone algæ, mingled with *Gorgonia*, among which rise a number of coral heads.

* * * * *

To the west of Long reef, especially between Carysfort and Key Largo, the coral sand rises here and there, in the form of shoal sandbanks, intermixed with coral heads—an arrangement which is probably owing to the more rapid currents flowing in that part of the channel, which is precisely the turning-point of the direction of the reef. Such heads occur again about a mile and a half off Vermont key, half way between Key Tavernier and Indian key, outside of which *Gorgonia* and sponges are very abundant, upon a hard, white sand bottom. Similar heads are seen between Long key and Tennessee reef, and nearer the reef there are shoals of white coral sand, covered with *Gorgonia*; but farther west, off Duck key, the bottom becomes softer. Off Bahia Honda, again, it is rocky—that is, studded with large heads, surmounted with soft, muddy sand. This change in the character of the bottom is more obvious westward, where the heads are fewer and the bottom more generally muddy, or covered with finer-grained sand. For instance, hard sand is observed between Loggerhead key and Saddle bluff; but nearer the reef, as far as the American shoals, we have soft mud, with shoals and coral heads. Off Boca Chica, the channel way has also a bottom of soft coral mud, while shoals, with coral heads, may be traced for three-fourths of a mile along the shores, as, again, towards the Sambos, in a depth of from three to two fathoms. The softness of the bottom in the vicinity of Key West, considered in connexion with the scarcity of coral heads in that region, shows that a soft mud formation is unfavorable for the growth of corals; and, indeed, this holds also good for the flats north of the keys.

* * * * *

The Main-land.

* * * * *

A careful survey of all the varieties of rock occurring at Key West, as well as their peculiar superposition, had prepared us for a minute comparison between the keys and the main-land; but, nevertheless, we were no less surprised than delighted to find that the solid foundation of the main-land consisted of the same identical modifications of coral rocks which form the keys. Along all that part of the shore which was examined, as well as upon the shores of the Miami, we found everywhere the same coarse, oolitic rock, with cross-stratification, consisting of thin beds, dipping at various angles in different directions, precisely as we find it at the western extremity of Key West, excepting, perhaps, that the cross-stratification is here more prominent, the strata dipping more frequently in several directions within the same extent.

* * * * *

Coast Survey.

But it may be asked, what is the practical use of such detailed descriptions of the coral reefs for the coast survey? We need only allude to the universal impression of the dangers arising to navigation, from the growth of such reefs, to satisfy the most skeptical that a minute knowledge of the extent and mode of formation of those belonging to our own shores must be of paramount importance, were it only with reference to the position of light-houses. But there is another subject connected with this investigation, which is not less momentous. It is well known that in the Pacific, coral reefs have been raised above the levels at which they were formed by the agency of the living animals, and also that in other localities, sometimes in close connexion with those just mentioned, the ground is subsiding. These changes have been so often observed, whenever coral reefs occur, that the idea of subsidence and upheaval is naturally connected with the features of coral reefs, and the question at once arises, whether the reefs on our shores are thus undergoing variations of level, independently of their natural growth. We have seen how extensive are the changes produced merely by the normal growth of the corals, and the facts accompanying their increase. It now remains for us to ascertain whether this growth has taken place, or does at present take place, upon ground which has changed or is now changing its relative level in reference to the sea.

The facts already described afford a sufficient answer to the question. We are satisfied that as far as coral formations have been observed upon the main-land of Florida, and within the present extent of the coral reefs, no change of the relative level has taken place either by subsidence or upheaval of the coral ground, and that all the modifications which the reef has presented at successive periods have been the natural consequence of the growth of reef-building corals, with the subsequent accumulation of their products in the manner described above.

* * * * *

There is in reality but one way of accounting for this equality of level in the successive reefs; which is, to suppose that their loftiest ridges are the maximum height at which materials can be accumulated by the natural agency of gales, and we have sufficient evidence to justify the adoption of this view.

The fact that, at present, the highest tides during the most severe gales do not reach the level of the bluff summits along the shores of the main-land, or even that of the maximum height of Key Largo or Key West, does not invalidate this supposition, for when the shore bluffs of the main-land were formed, the ocean had full sweep over the ground now occupied by the reef and mud flats, which did not then exist; and when Key Largo and Key West attained their maximum height, the outer reef did not yet form a barrier, checking the violence of the Gulf Stream in that direction. But, even with the present obstruction, we have evidence of the occasional rise of the water to heights which fully justify our assumption, that even the highest ridges on the shores of the main-land and on the reef have been formed by the action of severe gales. For, in the year 1846, the water rose eight and a half feet above high-water mark at Key Vacas. Key West was entirely inundated during the same gale; and though that island is somewhat protected by the reef, even at present the rushes, driven upon it by the flood, may be seen among the trees and bushes, at a height almost equal to its loftiest summit. In 1841 the water rose ten feet above high-water mark at Cape Romaine, on the western shore of the peninsula.

These facts suffice to show that the explanation we have given of the formation of the reef is in accordance with the powers of the agencies to which it is ascribed, and, when taken in connexion with the peculiar arrangement of the materials of which they consist, seems to us to prove the justness of this view.

* * * * *

Physical Changes in the Gulf Stream.

There are several questions of the deepest scientific interest, which may be advanced by a due consideration of the facts observed upon the reefs of Florida. There we have a peninsula—a narrow, flat strip of land, projecting for about five degrees from the main land, between the Atlantic ocean and the Gulf of Mexico, and forming an effective barrier between the waters of the two seas, which otherwise, even by the change of a few feet in the relative level of the intervening peninsula, would communicate freely with one another; and this peninsula we now know to have been added to the continent, step by step, in a southerly direction.

We know that the time cannot be far behind us when the present reef, with its few keys, did not exist, and when the channel, therefore, was broader, and the Gulf Stream flowed directly along the main range of keys. We know, further, that at some earlier period the keys themselves were not yet formed, and that then the channel between Cuba and Florida was wider still, washing freely over the grounds now known as the mud flats, between the keys and the main land, and that there was then nothing to impede a free communication between the Gulf of

Mexico and the Atlantic ocean. The channel of the Gulf Stream was not only wider—it was also less shallow along its northern borders, for the whole extent of soundings south of the main land of Florida was an uncovered coral ground, upon which the deep-water species were just beginning to spread. But we may trace the change farther. There was a time when neither the southern bluffs of the continent, nor Long key within the everglades, nor even the everglades themselves, existed; when, therefore, the Gulf Stream had a broad communication with the Atlantic, and the southern shores of the United States extended in almost unbroken contiguity from west to east, from the shores of Texas and Louisiana to St. Augustine. At that time the gulf channel was, in reality, a broad bay, as broad as the gulf itself, destitute of all those obstructions which now cause the tropical current to follow such a circuitous course between the West India islands, through the Caribbean Seas, and around the peninsula of Florida. The influence which the Gulf Stream has upon the climate of the Atlantic is so well known, that its connexion with the changes which the current itself has undergone within a comparatively recent period cannot be overlooked. If it is true, as we have every reason to believe, that the temperature of the Gulf Stream, in connexion with the temperature of the southwesterly winds blowing obliquely across the Atlantic, modifies that of the western coast of Europe,—if it is true that the Gulf Stream and the southwest winds have an influence in determining the course of the isothermal lines upon the two sides of the Atlantic, and of raising beyond their normal altitude the mean annual temperatures of northwest Europe, then we may look to the physical changes which have occurred on the southeastern extremity of the North American continent for the cause, or at least a partial cause, of those changes of temperature which have taken place in the beginning of the present period, in those very northwestern portions of Europe which are now so much warmer than the corresponding latitudes on the American continent, and which, soon after the accumulation of the glacial drift, had as low mean annual temperatures as the coasts of Labrador, Nova Scotia, and New England in our day.

* * * * *

Changes in ages to come.

Among the questions contained in your instructions, you ask whether the growth of coral reefs can be prevented, or the results remedied, which are so unfavorable to the safety of navigation. I may say that here, as in most cases where the operations of nature interfere with the designs of man, it is not by a direct intervention on our part that we may remedy the difficulties, but rather by a precise knowledge of their causes, which may enable us, if not to check, at least to avoid the evil consequences. I do not see the possibility of limiting in any way the extraordinary increase of corals, beyond the bounds which nature itself has assigned to their growth. We have seen how successfully several reefs have been formed, more or less parallel, within the limits of the peninsula of Florida, as well as beyond the main land. We have seen, also, how these parallel or concentric reefs have been gradually transformed into main land by the accumulation of coral sand and mud with other loose

materials, and also that the keys are now slowly annexed to the main land, by the same process. We may therefore safely infer, that, as far as the conditions exist for the formation of similar accumulations of loose materials, they will continue to occur, but they will never extend beyond the natural foundation from which a coral reef may rise; and as we now have sufficient evidence that this foundation is a sea-bottom, under from 12 to 20 fathoms, we may be satisfied that outside of the present outer reef, where the slope is steep, sinking rapidly to unfathomable depths, there is no opportunity for the growth of a new reef.

Here and there the reef may widen somewhat, towards the Gulf Stream, within those limits at which the depth does not exceed twenty fathoms, and from the knowledge we already possess of the soundings outside the reef, we know positively that this is nowhere a broad stream; we may therefore rest assured that the changes which are going on will chiefly consist in bringing up the reef, for its whole extent, to the surface of the water, with occasional intervening channels kept open by the currents, such as exist now between the keys; that this reef once matured, will be covered by coral debris, becoming transformed into a range of keys, similar to that which exists now inside of it; that the depth of the ship channel between the reef and the main range of keys will gradually lessen, and the channel itself be changed into mud flats, similar to those stretching now between the keys and the main land. In still more remote ages the present mud flats may become swamps, elevated above the reach of the tide-waters, like the everglades; and this process may perhaps be extended to the present ship channel. But unless some great revolution in nature modifies the present relative level between land and sea, it may safely be maintained that the present outer reef is the final southern boundary of the North American continent, and that the sooner a system of light-houses and signals is established along the whole reef, the better; for this is, after all, the shore which is to be lighted, and not the range of keys which is within the reef. In relation to the western range of keys, and the western extremity of the reef, we may expect, in course of time, to see the depression between the Marquesas and Tortugas gradually lessened by the increase of the reef, so that the westernmost group of islands may finally stand in as close connexion with the keys more to the west as they now bear to each other, the passage between them being reduced to as narrow a channel as Boca Grande, between the Marquesas and the Mangroves.

The shoals west of Cape Sable may, undoubtedly, also increase in extent westward; but how far the currents from the northwest may limit this accumulation, in connexion with the changes which the currents themselves may undergo by the increase of the keys to the west, it is beyond the power of human foresight to determine.

These practical results—for so we venture to call the general conclusions last presented—although they are purely scientific deductions from general principles, may satisfy the most obstinate supporters of the matter-of-fact side of all questions, of the advantages of scientific illustrations in the daily walks of life, and also justify the course which

has been followed with so much success by the Coast Survey, in combining the strictest scientific methods with its practical operation.

Respectfully submitted:

L. AGASSIZ.

Professor A. D. BACHE,
Superintendent of the Coast Survey.

APPENDIX No. 11.

List of Coast Survey maps, sketches, and preliminary charts, engraved and engraving.

1. LIST OF MAPS ENGRAVED.

No. 1.	New York bay and harbor and approaches.....	80000
2.	.. Do.....do.....do.....do.....No. 1...	30000
3.	...Do.....do.....do.....do.....No. 2...	
4.	...Do.....do.....do.....do.....No. 3...	
5.	...Do.....do.....do.....do.....No. 4...	
6.	...Do.....do.....do.....do.....No. 5...	
7.	...Do.....do.....do.....do.....No. 6...	
8.	Map of Delaware bay and river and approaches, No. 1	80000
9.	Map of Delaware bay and river and approaches, 2d engraved plate, No. 1.....	
10.	Map of Delaware bay and harbor and approaches, No. 2.....	
11.	Map of Delaware bay and harbor and approaches, No. 3.....	
12.	The harbor of New Bedford.....	40000
13.	The harbor of New London.....	20000
14.	Fisher's Island sound.....	40000
15.	Holmes' Hole and Tarpaulin Cove harbors.....	20000
16.	Oyster or Syossett bay.....	30000
17.	Little Egg harbor.....	30000
18.	Harbor of Annapolis.....	60000
19.	New Haven harbor.....	30000
20.	Harbor of Edgartown.....	20000
21.	Harbors of Black Rock and Bridgeport.....	20000
22.	Huntingdon bay.....	30000
23.	Nantucket harbor.....	20000
24.	Harbor of Sheffield and Cawkin's islands.....	20000
25.	Mouth of Chester river.....	20000
26.	Harbors of Captain's islands, east and west.....	20000
27.	Long Island sound, sheet No. 2.....	80000
28.	Do.....do.....No. 3.....	80000
29.	Re-engraving lower sheet of the Delaware.....	80000
30.	Pasquotank river.....	60000
31.	Cat and Ship Island harbors.....	40000

32. Harbor of Hyannis.....	$\frac{1}{30000}$
33. South side Long Island, No. 1.....	$\frac{1}{80000}$
34. Hart and City islands and Sachem's Head.	
35. Mobile entrance.	
36. Chart of Hell Gate.	
37. Richmond's Island harbor.....	$\frac{1}{20000}$

2. LIST OF SKETCHES AND PRELIMINARY CHARTS ENGRAVED.

No. 1. Sketch chart of Nantucket shoals, (3d edition).....	$\frac{1}{200000}$
2. ....Do.....Buttermilk channel, New York harbor	$\frac{1}{50000}$
3. ....Do.....Cape Hatteras cove.....	$\frac{1}{20000}$
4. ....Do.....Cape Hatteras inlet.....	$\frac{1}{20000}$
5. ....Do.....Bull's Bay harbor.....	$\frac{1}{40000}$
6. ....Do.....Beaufort harbor, North Carolina.....	$\frac{1}{30000}$
7. ....Do.....St. Andrew's shoals, Georgia.....	$\frac{1}{60000}$
8. ....Do.....Nantucket shoals, re-engraved and enlarged.....	$\frac{1}{200000}$
9. Hatteras inlet, from re-survey.....	$\frac{1}{20000}$
10. Cape Canaveral shoals.....	$\frac{1}{60000}$
11. Seacoast Maryland and Delaware.....	$\frac{1}{200000}$
12. Hatteras shoals.....	$\frac{1}{120000}$
13-15. Reconnaissance chart (McArthur's) western coast....	$\frac{1}{120000}$
16. Richmond's island.....	$\frac{1}{20000}$
17. Sketch chart of Nantucket shoals.....	$\frac{1}{200000}$
18-20. Second edition McArthur's chart western coast.	
21. Hatteras inlet, re-survey.....	$\frac{1}{20000}$
22-26. Five diagram maps Cat Island tides.	
27. Reconnaissance of Mosquito inlet.....	$\frac{1}{40000}$
28. ....Do.....Horn Island pass.....	$\frac{1}{30000}$
29. Sketch of Point Conception.....	$\frac{1}{40000}$
30. Sketch of Point Pinos and bay of Monterey.....	$\frac{1}{20000}$
31. Sketch of Mare Island straits.....	$\frac{1}{30000}$
32. Current chart Boston harbor.	
33. Reconnaissance of Cedar Keys.....	$\frac{1}{300000}$
34. ....Do.....Delta of the Mississippi.....	$\frac{1}{60000}$
35. ....Do.....Pass Christian.....	$\frac{1}{40000}$
36. Preliminary sketch of Galveston bay.....	$\frac{1}{200000}$
37. Sketch of Aransas pass.....	$\frac{1}{30000}$
38. Preliminary chart of Trinidad bay.....	$\frac{1}{20000}$
39. Entrance of the Columbia river.....	$\frac{1}{200000}$
40. Cape Hancock, or Disappointment.....	$\frac{1}{20000}$
41. Holmes' Hole.	
42-48. Seven maps of progress and geographical positions for annual report.	

3. LIST OF MAPS ENGRAVING.

No. 1. General chart of the coast.....	$\frac{1}{400000}$
2. No. 1, Long Island sound.....	$\frac{1}{80000}$
3. No. 1, Chesapeake bay.....	$\frac{1}{80000}$

No. 4. Patapsco river.....	80000
5. No. 2, south side Long Island.....	80000
6. No. 1, eastern series.....	80000
7. Boston harbor.....	40000
8. Muskeget channel.....	60000
9. Charleston harbor.....	30000
10. Key West.....	50000
11. Connecticut river.....	20000
12. No. 2, Mobile bay.....	80000

4. LIST OF SKETCHES AND PRELIMINARY CHARTS ENGRAVING.

No. 1. Seacoast of Delaware and Maryland; plate enlarged by electrotyping additional engraving, work of hy- drographic parties.....	20000
2. Beaufort harbor.....	30000
3. Preliminary chart of Humboldt bay.....	30000
4. Preliminary chart of the harbor of Key West.....	10000
5. Sketch of the entrance of the Chesapeake.....	10000
6. Re-engraving Nantucket shoals.....	20000
7. Chart of the harbor of San Diego.....	40000
8. Entrance of San Francisco.....	20000
9. Savannah river, vicinity of Savannah.....	30000
10. Savannah entrance.....	20000
11. Mobile bay.....	20000
12. Bull's bay, re-engraving.....	40000
13. Entrance to Columbia river.....	40000
14-16. New edition of McArthur's chart western coast.	
17. Point Pinos, view.	
18. View of mouth of Columbia river.	
19-26. Eight maps of progress and geographical positions.	

APPENDIX No. 12.

List of geographical positions determined by the United States Coast Survey.

The present list contains those geographical positions determined by the Coast Survey of the United States which may be supposed to be useful to the navigator, the geographer, and the surveyor. They embrace all the trigonometrical points of the coast survey, determined up to July, 1850, and also positions of a number of prominent objects determined by means of the plane-table.

For the purposes of the survey, the coast of the United States is divided into eleven sections, in all of which the work is carried on simultaneously. The survey being in different stages of progress in the several sections, and new results being added from year to year to those here given, the same divisions have been adopted in this publication. The several sections are defined as follows:

Sec. I. From Passamaquoddy bay to Point Judith.

Sec. II. From Point Judith to Cape Henlopen.

Sec. III. From Cape Henlopen to Cape Henry.

- Sec. IV. From Cape Henry to Cape Fear.
 Sec. V. From Cape Fear to the St. Mary's river.
 Sec. VI. From the St. Mary's river to St. Joseph's bay.
 Sec. VII. From St. Joseph's bay to Mobile bay.
 Sec. VIII. From Mobile bay to Vermilion bay.
 Sec. IX. From Vermilion bay to the Rio Grande.
 Sec. X. Coast of California, San Diego bay, to 42d parallel.
 Sec. XI. Coast of Oregon, 42d to 49th parallel.

The tables give the latitudes and longitudes of the trigonometrical points in each section, and their relative azimuths, or bearings, and distances. The manner in which these data have been obtained may be briefly explained here:

In each section a base line of from five to ten miles in length is measured with all possible accuracy. A series of triangles, deriving the length of their sides from this base, is then established along the coast, by the measurement of the angles between the intervisible stations. In this primary series the triangles are made as large as the nature of the country will permit, because the liability to error increases with the number of triangles.

On the bases furnished by the sides of the primary triangles, a secondary triangulation is next established, extending along the coast, and over the smaller bays and sounds, and determining a large number of points at distances of a few miles apart.

The distances between the points thus determined, as given in the tables, are liable to an average error of about one foot in six miles, until a final adjustment between the base lines shall have been made.

As, on the completion of the primary triangulation in each section, the several series form one connected chain, the different bases afford verifications of each other, and of the triangulation connecting them. The first three sections are thus connected at present.

Observations for latitude and azimuth are made at a number of stations of the primary triangulation in each section. The differences of latitude, longitude, and azimuth between these and other stations are then computed, under the supposition that the earth is a spheroid of revolution of the following dimensions, which are those determined by *Bessel* from all the measurements made to the present time, viz:

Equatorial radius	=	6377397.15 metres.
Polar radius	=	6356079.11 "
Eccentricity	=	0.0816968

It has been found that the differences of latitude and longitude, as computed in this manner from the distance and azimuth between two stations, and which are called *geodetic*, differ from those obtained by astronomical observations at the several stations, by quantities which are greater than the errors of the observations. Such disagreements are due to local irregularities in the figure and density of the earth, and the error resulting from them in the determinations of latitude and of the meridian plane is designated as *station error*. It amounts, according to the results obtained at present, to between one and two seconds of arc in the eastern section of the survey, and to about half a second in the sections south of the Delaware.

In order to eliminate the influence of station errors on the general

results, observations are made at a number of stations; the results are referred to a central station by means of the geodetic differences, and the mean of all is used for the computation of the positions given in the tables. The geographical positions must therefore be considered as liable to future changes, from the accumulation of new observations, and the final discussion of all the results obtained.

The *differences of longitude* are obtained, as has been stated, by computation, from the distances, latitudes and azimuths of the triangulation. In adding up these differences, from station to station, an accumulation of the unavoidable errors is highly probable. They are checked, however, by differences of longitude, determined by means of the electro-magnetic telegraph, in every section where the introduction of the latter makes it practicable.

SEATON STATION, in Washington city, has been selected as the centre for the telegraphic differences of longitude. The Sections at present connected by telegraph are Sections I, II, III and V. The first three being also connected by triangulation, the check on the geodetic differences of longitude is here obtained, and the agreement is very close.

The longitudes from Greenwich depend upon that of Cambridge observatory, as determined by chronometric differences between Liverpool and Cambridge, and by occultations, eclipses and moon culminations, observed at various observatories in the United States, and referred to Cambridge by means of telegraphic differences.

The following statement shows the result up to the present time:

Longitude of Cambridge from Greenwich.

	h.	m.	s.
By moon culminations observed at Cambridge, Hudson, Ohio, Wilkes' observatory, and National Observatory	4	44	28.4
By eclipses and occultations at Cambridge, Brooklyn, Philadelphia, and Wilkes' observatory.....	4	44	29.6
By chronometric differences.....	4	44	30.1

The longitude adopted for the present is 4h. 44m. 29.5s., or $71^{\circ} 07' 22''.50$.

In Sections IV, VI, VIII, IX, and X, the longitudes are counted from some central station in each. Sections IV and VIII will soon be connected by telegraph with Seaton station and Cambridge. In Sections VI and IX the longitudes from Greenwich will for some time depend upon less exact determinations. For the present we have the following data:

	o	'	"
Sec. IV. Stevenson's Point, west of Greenwich.....	76	10	43.5
Sec. VI. Cape Florida.....ditto.....	80	05	00
“ “ Sand key.....ditto.....	*81	52	43
Secs. VIII and IX. Fort Morgan, Mobile Point.....	88	00	25
Sec. X. Coast Survey observatory, near San Diego....	*117	13	22

Explanation of the tables.

The first column on the left contains the name of the several stations or triangulation points. Their general locality is indicated by the

* Corrected from data to November, 1852.

heading at the top of the page, by means of which they will be readily found on the sketches accompanying the tables. Sub-headings in the first column indicate the locality more minutely where it is practicable.

The stations are generally either prominent objects of permanence, such as spires, light-houses, beacons, &c., or they are the points on prominent hills, capes, or points of land, where signals have been erected for the purpose of the survey, and which are marked on the ground. In a small number of cases in the first three Sections, but much more frequently in the southern Sections, where settlements on the coast are sparse, and few permanent objects are to be found, the stations have no other distinguishing mark than the signal erected on the spot; and after its decay, the mark left on the ground, to designate the station point. The latter generally consists of posts or stones set around the point, while the centre of the station is designated by an earthen cone or glass bottle buried under the surface of the ground and marked on top by a stone or post. Where the station is on a rock, a copper bolt, or a hole filled with lead or sulphur, will be found to designate the exact spot.

The sketches showing the configuration of the land, as well as the relative positions of the stations, no great difficulty will be experienced in finding the latter, when desired for local surveys or reference. In any case where minute descriptions of particular points are required, they can be had by application addressed to the Coast Survey office.

The second and third columns contain the latitudes and longitudes of the stations named.

The fourth column contains the azimuth of the line joining the station named in the first column to that named in the fifth; that is to say, the angle which that line makes with the meridian of the former station, reckoned from south around by west, through the whole circle. The sixth column gives the back azimuth of the same line, or the angle which it makes with the meridian of the latter station, reckoned as before; the difference between the azimuths in the fourth and those in the sixth columns being 180° , less the inclination of the meridians at the two stations.

The seventh, eighth, and ninth columns give the distances, in metres, yards, and miles, between the stations named in the first and fifth columns. The relation of the metre to the yard used in obtaining these results, is—

1 metre = 1.0935696 yard, or 39.36850 United States standard inches.

For each station the azimuths and distances to two other stations are given. In every case the lines so given have actually been observed.

In each section the stations of the primary triangulation are given in a separate table, in which all the distances and azimuths observed are given. Whenever these primary stations afterwards occur in the columns of the general table, they are distinguished by being printed in small capitals.

Those points which are marked with an asterisk have been determined by means of the plane-table; their positions are not as accurate as those of the trigonometrical points, and are liable to be in error about three metres, or ten feet.

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
MASS. BASE { North End..... South End.....	42 03 04.52	71 12 03.88	.....	.....	.....	.....	.....	.....
	41 54 47.80	71 17 55.15	207 47 11.0	North Base.....	27 51 05.9	17326.1	18947.3	10.76
Beaconpole.....	41 59 40.37	71 26 40.36	252 34 17.8	North Base.....	72 44 04.5	21122.7	23099.1	13.11
			306 41 03.2	South Base.....	126 46 54.3	15091.1	16563.2	9.38
Great Meadow Hill.....	41 52 43.01	71 12 41.29	123 44 55.9	Beaconpole Hill.....	303 35 35.1	23223.4	25396.4	14.43
			182 34 09.4	North Base.....	2 34 34.3	19192.8	20988.7	11.92
Spencer Hill	41 40 41.07	71 29 19.79	185 57 35.5	Beaconpole Hill.....	5 59 21.9	35338.8	38645.4	21.96
			225 54 01.5	Great Meadow Hill.....	46 05 06.8	32056.5	35056.0	19.92
Copecut Hill	41 43 15.08	71 03 15.56	133 18 13.6	Beaconpole Hill.....	313 02 36.2	44424.6	48581.4	27.60
			143 21 13.1	Great Meadow Hill.....	323 14 56.0	21851.7	23896.4	13.58
Pocasset Hill	41 39 07.23	71 11 11.33	82 39 37.9	Spencer Hill.....	262 22 17.3	36474.8	39887.7	22.66
			150 41 02.5	Beaconpole Hill.....	330 30 43.0	43665.9	47751.7	27.13
McSparran Hill.....	41 29 44.71	71 27 03.81	235 09 31.9	Copecut Hill.....	55 14 48.3	13397.7	14651.3	8.32
			96 39 33.3	Spencer Hill.....	276 27 29.7	25343.7	27715.1	15.75
Quaker Hill			175 17 22.7	Great Meadow Hill.....	355 16 22.8	25251.7	27614.5	15.69
			180 33 30.8	Beaconpole Hill.....	0 33 46.5	55396.8	60580.2	34.42
			232 46 47.4	Copecut Hill.....	53 02 35.0	41452.8	45331.5	25.76
			231 43 41.4	Pocasset Hill.....	51 54 13.4	28069.8	30696.3	17.44
			171 10 20.7	Spencer Hill.....	351 08 50.4	20490.8	22408.1	12.73
			118 12 25.1	Spencer Hill.....	298 02 52.2	22634.1	24751.9	14.06
	41 34 55.17	71 14 57.32	60 26 12.5	McSparran Hill.....	240 18 10.8	19370.7	21183.2	12.04
			226 24 36.5	Copecut Hill.....	46 32 22.9	22392.9	24488.2	13.91
			160 33 29.5	Beaconpole Hill.....	340 25 41.1	48607.4	53155.6	30.20
			213 54 42.8	Pocasset Hill.....	33 57 12.9	9371.9	10248.8	5.82
			185 26 20.2	Great Meadow Hill.....	5 27 50.8	33091.6	36183.0	20.54

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Cuttyhunk	41 25 12.65	70 55 41.50	123 56 39.6 101 02 57.4 162 33 25.3	Quaker Hill	303 43 53.7	32270.1	35289.6	20.05
				McSparan Hill	280 42 11.5	44479.3	48641.2	27.64
				Copecut Hill	342 28 24.0	35008.5	38284.2	21.75
Indian Hill	41 25 44.51	70 40 19.45	135 36 03.3 87 27 21.3	Copecut Hill	315 20 50.1	45457.4	49710.8	28.24
				Cuttyhunk Hill	267 17 11.2	21430.4	23435.6	13.32
Manomet Hill	41 55 36.61	70 35 06.87	59 44 29.0 7 28 44.5 96 18 51.2	Copecut Hill	239 25 42.9	45184.9	49412.8	28.08
				Indian Hill	187 25 16.6	55754.3	60971.2	34.64
				Beaconpole Hill	275 44 22.8	71625.4	78327.4	44.51
Shootflying Hill	41 41 05.18	70 20 28.37	44 17 19.4 143 03 18.9	Indian Hill	224 04 09.3	39601.0	43306.4	24.61
				Manomet Hill	322 53 33.3	33672.7	36823.4	20.92
Blue Hill	42 12 41.92	71 06 31.61	305 57 30.7 12 58 42.7 49 08 49.0 355 14 53.9	Manomet Hill	126 18 33.6	53642.2	58661.5	33.33
				Great Meadow Hill	192 54 35.5	37951.2	41502.3	23.58
				Beaconpole Hill	228 55 18.9	36776.9	40218.1	22.85
				Copecut Hill	175 17 05.0	54693.7	59811.4	33.98
Thompson's Hill	42 36 40.03	70 43 27.99	351 21 41.2 35 37 01.1	Manomet Hill	171 27 18.4	76863.6	84055.7	47.76
				Blue Hill	215 21 27.9	54491.2	59589.9	33.86
Wachusett	42 29 18.82	71 52 53.34	326 32 27.9 295 31 36.9 261 27 23.0	Beaconpole Hill	146 50 05.5	65657.3	71800.9	40.80
				Blue Hill	116 02 50.9	70700.0	77315.4	43.93
				Thompson's Hill	82 14 20.0	95990.1	104971.9	59.64
Holt's Hill	42 38 26.13	71 06 03.86	45 55.6 275 55 16.7	Blue Hill	180 45 36.9	47647.2	52105.5	29.60
				Thompson's Hill	96 10 34.9	31066.0	33972.8	19.30
Unkonoque	42 58 58.04	71 34 58.57	335 24 29.1 24 06 11.4	Blue Hill	155 43 44.4	94076.8	102879.6	58.45
				Wachusett	203 54 01.9	60092.8	65715.7	37.34

United States Coast Survey.—Geographical Positions. Section I.—Primary Stations. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Unkonoonuc—Continued	42 58 58.04	71 34 58.57	300 09 31.2 313 48 08.9	Thompson's Hill	120 44 31.0	81460.7	89083.0	50.61
				Holt's Hill	134 07 47.8	54750.9	59873.9	34.02
Agamenticus.....	43 13 22.90	70 41 11.75	70 12 56.0 27 44 48.1 2 36 56.7	Unkonoonuc	249 36 11.1	77684.9	84953.9	48.27
				Holt's Hill	207 27 51.7	73007.4	79838.7	45.36
				Thompson's Hill.....	182 35 24.0	68040.8	74407.4	42.28
Patuccawa	43 07 11.92	71 11 30.37	325 47 58.6 352 02 52.8 254 15 13.4 64 34 32.8 39 02 42.5	Thompson's Hill	146 07 03.1	68212.3	74594.9	42.38
				Holt's Hill.....	172 06 34.9	53762.1	58792.6	33.40
				Agamenticus	74 35 57.6	42638.0	46627.6	26.49
				Unkonoonuc.....	244 18 31.1	35322.0	38627.3	21.95
				Wachusett	218 34 35.4	90006.6	98428.5	55.93
Gunstock	43 31 02.64	71 21 50.51	16 44 17.3 342 22 46.4 300 32 51.5 332 25 20.0	Unkonoonuc	196 35 17.3	61990.5	67790.9	38.52
				Patuccawa	162 29 51.9	46306.8	50639.7	28.77
				Agamenticus	121 00 46.2	63900.7	69879.9	39.70
				Thompson's Hill.....	152 51 32.1	113350.7	123956.9	70.43
Ossipee	43 35 17.23	70 44 06.54	35 35 53.5 354 26 42.5	Patuccawa	215 17 05.0	63832.1	69804.8	39.66
				Agamenticus	174 28 42.7	40747.8	44560.5	25.32
Mount Independence.....	43 45 32.18	70 18 53.04	60 54 21.4 72 46 35.8 26 55 49.0	Ossipee	240 36 56.2	38850.1	42485.3	24.14
				Gunstock	252 03 08.9	88809.1	97119.0	55.18
				Agamenticus	206 40 27.6	66699.8	72940.9	41.44
NARRAGANSETT BAY.								
McSPARRAN HILL.....	41 29 44.71	71 27 03.81	.....	.....	.....	.....	.....	.....
QUAKER HILL	41 34 55.16	71 14 57.34	60 26 12	McSparran Hill.....	240 18 11	19370.7	21183.2	12.04

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Pocasset.....	41 39 07.20	71 11 11.36	51 54 13 33 57 13	McSparran Hill..... Quaker Hill.....	231 43 41 213 54 43	28069.8 9371.9	30696.3 10248.8	17.44 5.82
East Rock, Seconnet.....	41 27 02.41	71 11 17.31	102 55 51 160 44 22	McSparran Hill..... Quaker Hill.....	222 45 24 340 41 56	22522.3 15449.5	24629.7 16895.1	13.99 9.60
Whitman	41 40 31.71	71 26 58.43	21 26 301 48 55	McSparran Hill..... Quaker Hill.....	180 21 23 121 56 56	19958.6 19655.2	21826.1 21494.3	12.40 12.21
Mount Hope.....	41 40 23.95	71 14 05.17	90 50 15 42 30 52	Whitman..... McSparran Hill.....	270 41 41 222 22 15	17885.4 26721.2	19559.0 29221.5	11.11 16.60
Nootas Hill.....	41 32 10.78	71 07 04.82	31 38 29 114 53 22	East Rock..... Quaker Hill.....	211 35 41 294 48 09	11170.7 12065.5	12216.0 13194.5	6.94 7.50
Kinnicut	41 47 45.72	71 21 36.51	29 05 03 322 31 56	Whitman..... Mount Hope.....	209 01 29 142 36 57	15315.9 17160.7	16749.0 18766.4	9.52 10.66
Arnold.....	41 45 12.32	71 23 20.79	30 10 48 304 39 25	Whitman..... Mount Hope.....	210 08 24 125 45 35	10011.8 15622.3	10948.6 17084.1	6.22 9.71
Fort Independence.....	41 47 32.29	71 23 12.42	21 56 40 316 12 26	Whitman..... Mount Hope.....	201 54 10 136 18 31	13985.8 18289.5	15294.5 20000.9	8.69 11.36
Pomham	41 46 40.02	71 21 07.06	35 35 01 319 54 55	Whitman..... Mount Hope.....	215 31 07 139 59 35	13964.6 15153.9	15271.3 16571.9	8.68 9.42
Pomham Beacon.....	41 46 32.98	71 22 06.12	34 44 00 140 05 13	Arnold..... Fort Independence.....	214 43 10 320 04 28	3027.7 2385.7	3311.0 2608.9	1.88 1.48
Pawtuxet Beacon	41 45 33.40	71 22 29.99	61 01 05	Arnold.....	241 00 31	1341.7	1467.2	0.83

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Pawtuxet Beacon—Contin'd.	41 45 33.40	71 22 29.99	165 02 43	Fort Independence.....	345 02 15	3796.5	4151.7	2.37
Pawtuxet Church	41 45 57.21	71 23 09.53	27 48 08 309 12 09	Whitman..... Mount Hope.....	207 45 36 129 18 11	11349.4 16247.3	12411.3 17767.5	7.05 10.09
Friends' College	41 49 58.45	71 23 35.38	15 02 05 323 19 33	Whitman..... Mount Hope.....	194 59 50 143 25 52	18101.2 22081.3	19794.9 24147.4	11.24 13.71
College Hill	41 50 16.71	71 23 39.69	166 33 15 253 23 08	Beaconpole	346 31 15	17880.2	19553.3	11.11
				Great Meadow Hill.....	73 10 27	15841.7	17324.0	9.84
Providence Congregational Church.	41 49 10.78	71 24 29.83	12 06 45 318 20 16	Whitman..... Mount Hope.....	192 05 07 138 27 12	16376.4 21734.3	17908.7 23768.0	10.17 13.50
Providence Unitarian Church.	41 49 25.78	71 23 59 03	14 08 00 320 33 52	Whitman..... Mount Hope.....	194 06 06 140 40 32	16949.3 21623.8	18535.2 23647.1	10.53 13.43
Providence Baptist Church ..	41 49 36.78	71 24 11.16	12 57 21 313 48 49	Whitman..... Kinnicut	192 55 30 133 50 32	17252.5 4947.6	18866.8 5410.5	10.71 3.07
Swanзей Belfry	41 45 01.06	71 13 09.85	66 37 20 8 30 40	Whitman..... Mount Hope.....	246 28 08 188 30 03	20876.4 8643.5	22829.8 9452.2	12.97 5.37
Neutacoukanut	41 48 38.95	71 27 42.15	280 58 29 316 32 35	Kinnicut	101 02 32	8597.9	9402.4	5.34
				Arnold	136 35 30	8777.4	9598.6	5.45
Batty's Farm	41 45 32.75	71 24 14.86	221 41 41 140 13 03	Kinnicut	41 43 26	5495.3	6009.5	3.41
				Neutacoukanut	320 10 45	7476.9	8176.5	4.64
Prospect Hill	41 49 42.43	71 23 59.89	69 07 12 344 43 34	Neutacoukanut	249 04 43	5490.0	6003.7	3.41
				Fort Independence.....	164 44 06	4161.3	4550.7	2.58

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

S. Doc. 3.

171

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Bullock's Neck	41 44 40.74	71 21 06.71	151 15 45 107 28 11	Fort Independence	331 14 21	6036.3	6601.1	3.75
Rocky Point.....	41 41 27.51	71 21 29.05	19 42 18 323 07 42	McSparran Hill	199 38 36	23023.7	25178.0	14.30
Nayat Light	41 43 27.91	71 20 01.31	21 06 13 335 59 54	Quaker Hill	143 12 02	15121.9	16536.8	9.39
Warren Spire	41 43 46.29	71 16 41.73	29 04 29 67 13 22	McSparran Hill	201 01 32	27213.1	29759.4	16.90
Prince	41 44 32.45	71 18 35.21	320 49 08 57 29 22	Quaker Hill	156 03 16	17310.7	18930.4	10.75
High Rocks	41 37 45.36	71 25 47.84	162 21 12 253 11 11	McSparran Hill	208 57 35	29687.7	32465.5	18.44
Pojack	41 39 02.74	71 24 06.99	259 44 34	Whitman.....	247 06 32	15468.8	16916.2	9.61
Warwick Neck	41 41 18.94	71 22 28.75	34 58 21 278 14 22	Mount Hope.....	146 52 08	9885.9	10810.9	6.14
Warwick Light	41 39 59.26	71 22 22.36	266 09 54 312 16 50	Whitman.....	237 23 47	13800.7	15092.0	8.57
Warwick Beacon	41 39 22.82	71 23 15.21	16 33 25 112 23 16	Whitman.....	342 20 25	5385.1	5889.0	3.34
Patience Island	41 39 31.27	71 21 03.57	260 25 53	Whitman.....	73 18 58	16977.2	18565.7	10.54
				Mount Hope.....	193 22 01	17694.3	19349.9	10.99
				Mount Hope.....	79 51 14	14145.0	15468.6	8.78
				High Rocks.....	214 56 09	8038.4	8790.5	4.99
				Mount Hope.....	98 19 56	11768.5	12869.7	7.31
				Mount Hope.....	86 15 25	11525.0	12603.4	7.16
				Quaker Hill	132 21 46	13932.5	15236.2	8.65
				McSparran Hill	196 30 53	18602.9	20343.6	11.56
				Whitman.....	292 20 48	5583.2	6105.6	3.47
				Mount Hope.....	80 30 31	9813.6	10731.6	6.10

United States Coast Survey.—Geographical Positions. Section 1.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Patience Island—Continued.	41 39 31.27	71 21 03.57	315 05 53	Quaker Hill	135 09 57	12017.9	13142.4	7.47
Pappoose Squaw	41 39 13.01	71 17 41.50	246 21 40 334 26 33	Mount Hope..... Quaker Hill	66 24 04 154 28 21	5461.8 8815.6	5972.9 9640.5	3.39 5.48
Rum Stick	41 42 21.86	71 17 46.73	71 57 18 344 06 09	Rocky Point..... Quaker Hill	251 54 50 164 08 02	5406.8 14327.0	5912.7 15667.6	3.36 8.90
Pine Hill.....	41 37 58.27	71 20 14.80	242 14 43 307 30 34	Mount Hope..... Quaker Hill	62 18 49 127 34 05	9660.6 9270.5	10564.5 10137.9	6.00 5.76
Hope Island.....	41 36 08.10	71 21 38.64	137 43 35 233 00 37	Whitman	317 40 01	10994.9	12023.7	6.83
Prudence	41 36 22.22	71 18 21.57	218 29 05	Mount Hope.....	53 05 38	13130.4	14359.0	8.13
Hog Island.....	41 38 38.19	71 16 29.52	122 48 29 218 29 05	Whitman	302 42 45	14222.1	15552.9	8.84
Castle Island Beacon.....	41 39 11.78	71 16 51.13	342 45 04	Mount Hope.....	38 31 56	9529.2	10420.9	5.92
Bristol Court-house.....	41 40 10.48	71 16 04.64	31 44 21 239 52 33 341 34 42	Prudence..... Quaker Hill	211 43 07 162 46 05	4931.5 7203.4	5392.9 7877.4	3.06 4.48
Wickford Hill	41 34 28.32	71 27 41.76	261 26 20 350 53 20	Mount Hope..... Quaker Hill	59 54 23 161 35 58	4437.8 8343.1	4853.1 9123.8	2.76 5.18
				Mount Hope..... Quaker Hill	81 27 39 170 54 05	2794.4 9850.9	3055.9 10772.7	1.74 6.12
				Quaker Hill	87 23 36	17725.8	19384.4	11.01
				McSparran Hill.....	174 15 38	8792.9	9615.7	5.46
				Quaker Hill	86 22 28	16288.7	17812.8	10.12
				McSparran Hill.....	183 50 26	8547.6	9347.4	5.31

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.		Distance. Metres.	Distance. Yards.	Distance. Miles.
					° ' "	° ' "			
Wickford Light.....	41 34 13.70	71 26 01.70	9 50 52 101 01 27	McSparran Hill..... Wickford Hill	189 50 11 281 00 21		8421.5 2361.5	9209.5 2582.5	5.23 1.47
Batty	41 32 11.01	71 22 15.27	157 01 35 216 41 07	Whitman	336 58 27		16779.0	18349.0	10.43
				Mount Hope.....	36 46 33		18973.0	20748.3	11.79
Quonsett	41 35 24.36	71 24 12.75	236 37 42 335 27 32	Mount Hope..... Batty	56 44 26 155 28 51		16826.4 6555.9	18400.9 7169.3	10.45 4.07
Fox Island	41 33 14.01	71 24 43.53	169 55 00 228 01 59	High Rocks	349 54 17		8501.9	9297.4	5.28
				Mount Hope.....	48 09 03		19856.4	21714.4	12.34
Spindle	41 34 24.42	71 24 42.73	20 46 03 91 40 43	McSparran Hill..... Wickford Hill	200 44 29 271 38 44		9227.2 4148.9	10090.5 4537.1	5.73 2.57
Prudence South	41 34 42.24	71 19 11.96	100 35 45 42 20 01	Quonsett	280 32 21		7086.3	7749.3	4.40
				Batty	222 17 59		6308.4	6898.6	3.91
Slate Hill	41 32 18.77	71 15 38.62	191 13 00 271 08 04	Quaker Hill	11 13 28		4918.3	5378.5	3.06
				Nootas Hill.....	91 13 44		11912.7	13027.4	7.40
Conanicut Neck.....	41 34 22.64	71 21 58.91	233 44 36 293 24 28	Prudence	53 46 59		6239.3	6823.1	3.87
				Slate Hill	113 28 39		9604.1	10502.7	5.96
Gould Island.....	41 32 02.06	71 20 21.03	199 00 49 265 28 08	Prudence	19 02 08		8488.8	9283.1	5.72
				Slate Hill	85 31 14		6565.9	7180.2	4.07
Miantonomy	41 30 34.80	71 18 16.44	82 50 44 146 45 45	McSparran Hill..... Whitman	262 44 55 326 39 58		12326.7 22026.1	13480.1 24087.0	7.65 13.68
Hazard	41 28 20.99	71 18 56.59	102 54 57 192 42 45	McSparran Hill..... Miantonomy	282 49 34 12 43 11		11592.6 4231.6	12677.3 4627.5	7.20 2.62

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Half Way Rock.....	41 33 47.60	71 19 37.34	342 29 28 50 51 37	Miantonomy..... Batty.....	162 30 22 230 49 52	6235.8 4719.0	6819.2 5160.7	3.87 2.93
Rose Island	41 29 45.96	71 20 13.44	240 56 22 325 46 08	Miantonomy..... Hazard	60 57 39 145 46 59	3103.9 3169.5	3394.3 3466.1	1.92 1.96
Poor House Belfry	41 30 24.62	71 19 22.31	258 22 00 351 06 16	Miantonomy..... Hazard	78 22 44 171 06 33	1559.8 3859.9	1705.7 4220.9	0.96 2.39
Goat Island Light.....	41 29 33.83	71 19 18.11	91 49 15 347 28 36	McSparran Hill..... Hazard	271 44 06 167 28 50	10805.9 2301.7	11817.0 2517.1	6.71 1.42
Fort Adams, (flag staff).....	41 28 45.25	71 19 53.25	213 35 41 299 38 44	Miantonomy..... Hazard	33 36 43 119 39 22	4057.6 1512.7	4437.2 1654.2	2.52 0.93
Dumplin	41 28 43.42	71 21 46.89	234 50 21 279 55 14	Miantonomy..... Hazard	54 52 40 99 57 08	5969.0 4010.9	6527.5 4386.2	3.70 2.49
Telegraph	41 27 45.56	71 19 50.64	110 07 47 202 42 17	McSparran Hill..... Miantonomy.....	290 02 59 22 43 19	10699.3 5659.5	11700.4 6189.0	6.64 3.51
Castle Hill.....	41 27 50.76	71 21 07.81	113 05 20 218 08 02	McSparran Hill..... Miantonomy.....	293 01 24 38 09 56	8975.1 6435.0	9814.9 7037.1	5.57 3.99
Newport Spire.....	41 29 12.23	71 18 28.70	34 00 06 82 00 36	Beacon Hill. (Sec. II)..... Tiff's Hill. (Sec. II).....	213 49 04 261 51 42	41721.9 18888.1	45625.8 20655.5	25.92 11.74
Beaver Tail Light.....	41 26 54.58	71 23 38.45	137 47 00 227 41 13	McSparran Hill..... Miantonomy.....	317 44 43 47 44 46	7087.9 10097.0	7751.1 11041.8	4.40 6.27
Meeting House Hill.....	41 26 43.09	71 28 13.00	17 55 48 110 46 48	Beacon Hill. (Sec. II)..... Tiff's Hill. (Sec. II).....	197 51 12 290 44 20	31550.9 5504.6	34503.1 6019.7	19.60 3.42

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Boston Neck.....	41 28 16.85	71 25 44.49	50 00 13 145 50 34	Meeting House Hill..... McSparan Hill.....	229 58 35 325 49 40	4821.3 3276.1	5272.4 3582.6	2.99 2.04
Tiverton Steeple.....	41 37 28.04	71 12 29.85	157 53 21 35 54 52	Mount Hope..... Quaker Hill.....	337 52 18 215 53 14	5857.2 5822.1	6405.3 6366.9	3.64 3.62
Fall River.....	41 42 37.07	71 08 24.45	62 29 49 30 48 41	Mount Hope..... Pocasset Hill.....	242 26 02 210 46 50	8884.1 7536.1	9715.4 8241.3	5.52 4.68
Slade.....	41 43 39.04	71 09 48.02	44 40 11 314 41 47	Mount Hope..... Fall River.....	224 37 20 134 42 43	8459.4 2717.5	9251.0 2977.8	5.26 1.69
Somerset Meeting House....	41 44 09.35	71 09 45.84	40 47 19 326 32 08	Mount Hope..... Fall River.....	220 44 26 146 33 02	9180.7 3411.9	10039.8 3731.2	5.70 2.12
Blackbeard.....	41 40 26.68	71 10 37.76	89 00 21 17 33 45	Mount Hope..... Pocasset Hill.....	268 58 03 197 33 22	4797.5 2571.1	5246.4 2811.7	2.98 1.60
Mattapoiset	41 42 38.29	71 12 30.70	27 47 44 327 14 25	Mount Hope..... Blackbeard.....	207 46 41 147 15 39	4685.0 4827.2	5123.4 5278.9	2.91 3.00
Toweset	41 41 57.04	71 14 12.70	356 31 42 299 15 57	Mount Hope..... Blackbeard.....	176 31 47 119 18 20	2877.5 5698.3	3146.8 6231.5	1.79 3.54
Butts	41 36 53.65	71 14 45.51	188 11 00 79 02 56	Mount Hope..... Prudence	8 11 26 259 00 31	6553.9 5095.3	7167.2 5572.1	4.07 3.17
Anthony	41 38 44.17	71 12 57.59	153 04 36 36 14 20	Mount Hope..... Butts	333 03 50 216 13 08	3452.3 4226.2	3775.3 41621.6	2.15 2.63
Cornell	41 37 16.75	71 08 55.43	62 29 55 344 47 27	Quaker Hill..... Nootas Hill.....	242 25 54 164 48 39	9449.0 9780.2	10333.1 10695.3	5.87 6.08

United States Coast Survey.—Geographical Positions. Section I.—Narragansett Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Barker	41 38 20.80	71 11 45.59	139 38 41 34 59 45	Mount Hope..... Quaker Hill.....	319 37 08 214 57 38	4985.6 7742.2	5452.1 8466.6	3.10 4.81
Wings	41 35 21.01	71 10 49.28	154 08 15 82 07 04	Mount Hope..... Quaker Hill.....	334 06 05 262 04 19	10386.3 5799.2	11358.2 6341.8	6.45 3.60
High Hill.....	41 32 48.80	71 12 38.42	140 28 29 208 17 23	Quaker Hill..... Wings	320 26 57 28 18 36	5054.4 5333.0	5527.3 5832.0	3.14 3.31
Windmill.....	41 32 31.37	71 11 29.39	132 39 20 86 10 11	Quaker Hill..... Slate Hill.....	312 37 01 266 07 24	6548.0 5789.2	7169.7 6330.9	4.06 3.59
Gibbs	41 29 34.43	71 16 08 15	304 46 16 249 00 05	East Rock..... Nootas Hill.....	124 49 29 69 06 05	8218.2 13490.8	8987.1 14753.1	5.10 8.38
Church's Point.....	41 29 57.86	71 12 02.90	348 55 52 82 46 31	East Rock..... Gibbs.....	168 56 22 262 43 47	5515.9 5733.6	6032.0 6270.1	3.42 3.56
Little Compton.....	41 31 10.15	71 10 39.64	249 23 51 6 31 07	Nootas Hill..... East Rock.....	69 26 14 186 30 42	5321.2 7692.4	5819.1 8412.1	3.30 4.77
Little Compton Belfry	41 30 31.37	71 09 57.27	86 38 03 162 35 12	McSparran Hill..... Mount Hope.....	266 26 42 342 32 26	23848.4 19160.0	26079.8 20952.8	14.81 11.90
Simmons.....	41 29 30.05	71 09 13.13	210 57 58 147 00 02	Nootas Hill..... Little Compton	30 59 23 326 59 04	5783.7 3682.4	6324.8 4026.9	3.59 2.28
Quicksand.....	41 29 59.44	71 06 51.10	175 32 25 74 37 24	Nootas Hill..... Simmons.....	355 32 16 254 35 49	4064.4 3416.5	4444.7 3735.8	2.52 2.12
Eldridge	41 31 43.89	71 04 47.15	104 36 15 46 12 55	Nootas Hill..... East Rock.....	284 34 44 226 08 35	3295.2 12540.7	3603.5 14714.1	2.04 7.79

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
12 Almy	° ' " 41 30 40.04	° ' " 71 01 28.68	° ' " 109 47 45 63 52 06	Nootas Hill	° ' ' 289 44 02 243 45 35	8277.9 15214.9	9052.4 16638.5	5.14 9.45
BUZZARD'S BAY.								
CUTTYHUNK	41 25 12.65	70 55 41.50	123 56 39.6 101 02 57.4	Quaker Hill	303 43 53.7 280 42 11.5	32270.1 44479.3	35289.6 48641.2	20.05 27.64
Mishaum Point	41 30 53.89	70 56 55.31	350 45 10 70 25 28	Cuttyhunk	170 45 58 250 15 57	10664.9 21232.9	11662.8 23219.7	6.63 13.19
Gooseberry Neck	41 29 17.85	71 01 58.49	247 07 22 310 48 40	Mishaum Point	67 10 43 130 52 50	7629.3 11565.1	8343.2 12647.3	4.74 7.19
Cuttyhunk Light	41 24 50.07	70 56 39.04	101 23 58 133 10 39	East Rock	231 14 17 313 03 44	20793.5 19889.3	22739.1 21750.4	12.92 12.36
Prospect Hill, Martha's Vine- yard.	41 21 54.58	70 44 29.83	219 19 40 111 26 46	Indian Hill	39 22 26 291 19 22	9171.9 16755.8	10030.2 18323.6	5.70 10.41
Naushon	41 29 22.81	70 44 12.16	64 18 40 321 15 07	Cuttyhunk	244 11 04 141 17 41	17761.4 8631.9	19423.3 9439.6	11.04 5.36
West Island	41 34 54.42	70 48 59.62	326 53 49 27 28 50	Naushon	146 56 59 207 24 24	12207.9 20222.1	13350.2 22114.3	7.59 12.57
Nashawena	41 25 28.73	70 51 45.44	84 51 10 192 24 42	Cuttyhunk	264 48 34 12 26 32	5502.9 17868.9	6017.8 19540.9	3.42 11.10
Tarpaulin Cove Light	41 28 05.69	70 45 07.52	208 21 15 156 54 44	Naushon	28 21 52 336 52 10	2703.5 13708.5	2956.5 14991.2	1.68 8.52

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

178

S. Dec. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Naushon, SW.	41 26 59.60	70 46 58.80	117 37 58 169 11 01	Mishaum Point	297 31 23	15611.0	17071.7	9.70
						14912.5	16307.9	9.26
Pasque	41 26 55.60	70 49 43.25	239 22 48 321 52 43	Naushon	59 26 27	8923.6	9758.5	5.54
						11798.4	12902.3	7.33
Penikese Island.....	41 26 55.93	70 55 05.76	14 35 52 160 54 53	Cuttyhunk	194 35 30	3292.4	3600.5	2.05
						7768.0	8494.9	4.83
Round Hill	41 32 22.58	70 55 29.47	1 12 21 242 33 10	Cuttyhunk	181 12 13	13265.4	14506.6	8.24
						10174.8	11126.9	6.32
Round Hill Light	41 32 15.66	70 54 57.93	47 10 38 239 25 50	Mishaum Point	227 09 16	3710.4	4057.6	2.31
						9638.8	10540.7	5.99
Pamanset River.....	41 31 38.43	70 59 07.98	294 03 33 254 55 52	Mishaum Point	114 05 01	3368.7	3683.9	2.09
						5244.5	5735.3	3.26
Sconticut Neck	41 35 00.46	70 50 59.24	19 52 31 47 21 44	Cuttyhunk	199 49 24	19277.9	21081.7	11.98
						11222.0	12272.0	6.97
Clark's Point	41 35 31.96	70 53 42.57	8 13 29 279 59 37	Cuttyhunk	188 12 10	19302.3	21108.5	11.99
						6654.6	7277.3	4.14
Clark's Point Light.....	41 35 32.07	70 53 42.77	22 55 55 280 00 56	Round Hill.....	202 54 43	6346.5	6940.4	3.94
						6660.0	7283.2	4.14
Padanaram (gray spire)	41 35 17.92	70 56 06.96	350 52 20 262 36 40	Round Hill.....	170 52 44	5478.2	5990.8	3.40
						8371.9	3687.5	2.10
Padanaram	41 35 37.07	70 56 14.62	278 45 39 350 06 18	Sconticut Neck	98 49 08	7390.5	8082.0	4.59
						6090.0	6659.9	3.78

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
New Bedford, (beacon).....	41 36 31.43	70 53 07.60	23 48 54 313 20 31	Clark's Point..... Scouticut Neck	203 48 31 133 21 56	2005.3 4087.7	2192.9 4470.2	1.25 2.54
New Bedford, (fort)	41 37 24.87	70 53 49.25	357 27 16 318 31 13	Clark's Point	177 27 20 138 33 06	3486.6 5944.7	3812.8 6500.9	2.17 3.69
New Bedford, (Baptist spire) ..	41 38 10.17	70 55 15.86	314 32 40 9 43 13	Scouticut Neck	134 35 29 189 42 06	8338.6 13654.6	9118.8 14932.3	5.18 8.48
Fair Haven, (black spire) ...	41 38 07.62	70 53 57.73	11 17 52 324 23 31	Round Hill..... Scouticut Neck	191 16 49 144 25 30	10853.4 7099.9	11868.9 7764.3	6.74 4.41
Swift's Hill.....	41 34 00.27	70 38 09.44	21 33 10 77 40 42	Prospect Hill..... Mishaum.....	201 28 58 257 28 15	24062.7 26719.1	26314.2 29219.2	14.95 16.60
Angelica Point.....	41 38 26.80	70 45 34.16	308 34 03 36 00 00	Swift's Hill..... West Island.....	128 38 57 215 57 44	13176.7 8096.1	14409.6 8853.6	8.18 5.03
West Island, 2.....	41 35 22.92	70 48 43.66	22 46 55 217 41 59	West Island..... Angelica Point.....	202 46 40 37 44 05	953.1 7171.0	1042.2 7841.9	0.59 4.46
Sampson's Hill, (Martha's Vineyard.)	41 22 39.58	70 28 41.13	109 26 30 198 28 16	Indian Hill..... Shootflying Hill	289 18 49 18 33 43	17192.4 35966.9	18801.0 39332.1	10.68 22.34
Falmouth.....	41 35 50.92	70 36 44.21	14 57 25 335 17 57	Indian Hill	194 55 03 155 23 18	19360.7 26859.6	21172.3 29372.9	12.03 16.69
Falmouth Spire	41 33 12.81	70 36 51.16	19 16 31 27 00 19	Indian Hill..... Prospect Hill.....	199 14 13 206 55 16	14648.6 23474.1	16019.2 25670.6	9.10 14.59
Hog Island Harbor.....	41 36 13.65	70 38 35.74	80 27 19 351 34 34	West Island..... Swift's Hill.....	260 20 25 171 34 50	14652.5 4159.6	16023.5 4548.8	9.10 2.58

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Mattapoiset Neck	41 37 44.40	70 47 50.12	17 04 00 297 09 32	West Island..... Swift's Hill.....	197 03 14 117 15 57	5484.6 15119.3	5997.8 16534.0	3.41 9.39
Mattapoiset, (gray spire)....	41 39 41.77	70 48 51.12	1 16 21 296 53 29	West Island..... Angelica Point.....	181 16 15 116 55 40	8866.2 5110.3	9695.8 5588.5	5.51 3.18
Ned's Point Light	41 39 01.15	70 47 24.92	345 55 48 276 00 17	Naushton	165 57 56	18391.0	20111.8	11.43
Wild Harbor	41 38 20.02	70 38 47.81	65 56 04 91 18 44	Wild Harbor	96 06 01	12032.3	13158.1	7.48
Wenauomet Neck	41 40 55.99	70 39 19.77	62 02 58 351 15 44	West Island..... Angelica Point.....	245 49 18 271 14 14	15519.3 9405.7	16971.4 10285.8	9.64 5.84
Sippican Neck	41 40 33.78	70 42 36.84	46 20 21 261 25 55	Angelica Point..... Wenauomet Neck.....	241 58 49 171 16 05	9807.6 4867.9	10725.2 5323.4	6.09 3.02
Sippican Church	41 42 07.77	70 45 26.71	326 01 25 284 35 36	Swift's Hill..... Wenauomet Neck.....	226 18 23 81 28 06	5671.9 4608.9	6202.7 5040.1	3.52 2.83
Seraggy Neck.....	41 39 57.13	70 38 54.33	162 03 09 357 06 56	Wenauomet Neck..... Wild Harbor	342 02 52 177 07 04	1908.7 2999.3	2087.3 3279.9	1.19 1.86
Bird Island Light.....	41 40 07.50	70 42 42.93	51 54 48 189 51 21	Angelica Point..... Sippican Neck	231 52 54 9 51 25	5034.3 822.7	5505.3 899.7	3.13 0.51
Charles' Neck	41 40 19.45	70 44 23.85	25 05 23 259 52 10	Angelica Point..... Sippican Neck	205 04 36 79 53 21	3836.8 2514.2	4195.8 2749.5	2.38 1.56
Great Hill.....	41 42 31.13	70 42 59.22	25 26 32 300 01 30	Angelica Point..... Wenauomet Neck.....	205 24 49 120 03 56	8345.6 5861.7	9126.5 6410.2	5.19 3.64

United States Coast Survey.—Geographical Positions. Section I.—Buzzard's Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Tempe's Knob.....	41 42 56.31	70 39 27.60	357 12 14 80 59 52	Wenauwet Neck..... Great Hill.....	177 12 20 260 57 31	3716.1 4952.8	4063.8 5416.2	2.31 3.08
Indian Neck.....	41 43 31.14	70 41 05.82	54 46 52 332 51 57	Great Hill..... Wenauwet Neck.....	234 45 37 152 53 08	3208.9 5377.4	3509.2 5880.6	1.99 3.34
Cromeset Neck.....	41 43 39.61	70 42 59.35	275 40 51 285 14 53	Indian Neck..... Tempe's Knob.....	95 42 07 105 17 12	2636.7 5072.8	2883.4 5547.5	1.64 3.15
Long Neck.....	41 44 18.07	70 38 24.15	62 35 51 11 39 23	Great Hill..... Wenauwet Neck.....	242 32 48 191 38 46	7162.1 6365.1	7832.3 6960.7	4.45 3.96
Back River Harbor.....	41 43 16.44	70 36 29.22	125 36 32 42 19 05	Long Neck..... Wenauwet Neck.....	305 35 14 222 17 11	3266.3 5858.0	3571.9 6406.2	2.03 3.64
Wareham, (Baptist spire)...	41 45 25.05	70 42 42.41	6 51 36 294 40 27	Cromeset Neck..... Back River Harbor.....	186 51 25 114 44 36	3276.6 9491.4	3583.2 10379.5	2.04 5.90
Monumet Church.....	41 44 30.31	70 35 28.45	84 42 16 31 38 54	Long Neck..... Back River Harbor.....	264 40 19 211 38 15	4077.1 2676.7	4458.6 2927.2	2.53 1.66
Pine Hill.....	41 42 28.99	70 33 37.35	19 25 02 175 08 51	Falmouth..... Manomet.....	199 22 58 355 07 51	13017.7 24385.6	14235.8 26667.4	8.09 15.15
Pocasset Spire.....	41 41 39.34	70 35 56.86	32 45 37 66 04 30	Wild Harbor..... Angelica Point.....	212 43 43 245 58 06	7309.9 14614.7	7993.9 15982.2	4.54 9.08
South Pocasset Spire.....	41 40 34.12	70 36 01.58	132 39 28 42 55 07	Tempe's Knob..... Wild Harbor.....	312 37 11 222 53 22	6475.4 5647.4	7081.3 6175.9	4.02 3.51
North Falmouth Spire.....	41 38 31.16	70 36 46.02	83 03 35 115 01 22	Wild Harbor..... Sippican Neck.....	263 02 21 294 57 29	2838.4 8953.9	3104.0 9791.7	1.76 5.56

United States Coast Survey.—Geographical Positions. Section I.—Martha's Vineyard. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Wood's Hole	41 31 36.59	70 39 20.32	58 39 03 7 12 07	Naushton	238 35 49	7926.0	8667.7	4.92
				Indian Hill	187 11 28	10946.8	11971.1	6.80
Naushon, Northeast	41 30 33.51	70 42 27.68	223 09 16 131 34 52	Swift's Hill	43 12 07	8746.5	9564.9	5.44
				West Island	311 30 32	12135.9	13271.4	7.54
Nobska Light	41 30 55.03	70 38 58.94	11 02 35 90 01 07	Indian Hill	191 01 42	9759.1	10672.3	6.06
				Mishaum	269 49 15	24956.0	27291.1	15.51
MARTHA'S VINEYARD.								
INDIAN HILL	41 25 44.51	70 40 19.45	135 36 03.3 87 27 21.3	Copecut	315 20 50.1	45457.4	49710.8	28.24
				Cuttyhunk	267 17 11.2	21430.4	23435.6	13.32
Prospect Hill	41 21 54.58	70 44 29.83	219 19 40 111 26 46	Indian Hill	39 22 26	9171.9	10030.2	5.70
				Cuttyhunk	291 19 22	16755.8	18323.6	10.41
No Man's Land	41 15 09.43	70 48 27.98	203 52 54 151 35 49	Prospect Hill	23 55 31	13670.5	14949.7	8.49
				Cuttyhunk	331 31 03	21161.6	23141.6	13.15
Molasha Hill	41 20 26.76	70 48 17.27	242 50 42 170 33 19	Prospect Hill	62 53 12	5940.3	6496.1	3.69
				Pasque	350 32 22	12159.8	13297.6	7.56
Gay Head	41 20 48.05	70 49 52.76	181 06 57 254 40 37	Pasque	1 07 02	11340.0	12401.1	7.04
				Prospect Hill	74 44 10	7781.2	8509.3	4.83
Gay Head Light	41 20 51.86	70 49 47.33	180 29 01 255 16 40	Pasque	0 29 04	11220.8	12270.8	6.97
				Prospect Hill	75 20 10	7628.8	8342.6	4.74
Sampson's Hill	41 22 39.58	70 28 41.13	109 26 30 198 28 16	Indian Hill	289 18 49	17192.4	18801.0	10.68
				Shootflying Hill	18 33 43	35966.9	39332.1	22.34

United States Coast Survey.—Geographical Positions. Section 1.—Martha's Vineyard. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Mctres.	Yards.	Miles.
Nashaquitsa Cliff.....	41 19 58.06	70 44 06.08	171 16 09 256 51 55	Prospect Hill..... Sampson's Hill.....	351 15 53 77 02 06	3635.8 22067.9	3976.0 24132.8	2.26 13.71
Watcha Pond.....	41 20 49.93	70 36 17.07	252 15 06 148 14 21	Sampson's Hill..... Indian Hill.....	72 20 07 328 11 41	11122.8 10689.7	12163.5 11690.0	6.91 6.64
Herring Pond.....	41 20 45.09	70 31 12.86	126 04 55 224 55 46	Indian Hill..... Sampson's Hill.....	305 58 54 44 57 26	15701.4 4990.4	17170.6 5457.4	9.76 3.10
Edgartown.....	41 23 49.52	70 32 34.66	78 01 09 108 14 04	Prospect Hill..... Indian Hill.....	257 53 17 288 08 57	16989.8 11360.5	18579.6 12423.5	10.55 7.06
Edgartown Spire.....	41 23 16.41	70 30 34.51	82 39 59 108 38 36	Prospect Hill..... Indian Hill.....	262 30 47 288 32 09	19571.8 14331.9	21403.2 15672.9	12.16 8.90
Cape Poge Light.....	41 25 13.79	70 26 44.37	76 09 07 92 56 27	Prospect Hill..... Indian Hill.....	255 57 21 272 47 28	25500.5 18947.7	27886.6 20720.7	15.85 11.80
Holmes' Hole Spire.....	41 27 12.93	70 35 58.90	109 20 28 150 08 38	Naushon..... Wood's Hole.....	289 15 01 330 06 25	12125.4 9379.9	13259.9 10257.5	7.53 5.82
West Chop.....	41 28 52.07	70 35 56.75	46 31 13 94 45 41	Indian Hill..... Naushon.....	226 28 19 274 40 13	8404.8 11530.6	9191.2 12609.5	5.52 7.16
West Chop Light.....	41 28 55.43	70 35 49.48	94 11 16 135 29 49	Naushon..... Wood's Hole.....	274 05 43 315 27 26	11690.8 6972.7	12784.7 7625.1	7.26 4.33
East Chop.....	41 28 02.59	70 33 29.62	65 54 52 326 03 44	Indian Hill..... Sampson's Hill.....	245 50 21 146 06 55	10421.8 12005.8	11397.0 13129.2	6.48 7.46
East Chop Telegraph.....	41 28 02.51	70 33 27.72	99 28 03 128 57 20	Naushon..... Wood's Hole.....	279 20 56 308 53 26	15153.8 10511.1	16571.8 11494.7	9.42 6.53

S. Dec. 3.

United States Coast Survey.—Geographical Positions. Section I.—Nantucket Sound. Sketch A.

184

S. Loc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Metres.	Miles.
Bowman's Point.....	41 32 34.27	70 35 44.56	26 47 35 331 47 11	Indian Hill..... Sampson's Hill.....	206 44 33 151 51 51	15481.9 22757.2	14157.2 20810.0	8.80 12.93
Davis' Neck.....	41 32 52.21	70 33 27.35	35 57 39 340 36 38	Indian Hill..... Sampson's Hill.....	215 53 06 160 39 48	17816.5 21905.2	16292.0 20030.9	10.12 12.45
Monaut Hill.....	41 33 03.32	70 32 11.18	39 57 46 345 45 59	Indian Hill..... Sampson's Hill.....	219 52 22 165 48 18	19300.2 21705.6	17648.8 19848.4	10.97 12.33
Succonset	41 33 29.26	70 28 14.95	49 35 48 77 21 27	Indian Hill..... Wood's Hole.....	229 27 48 257 14 07	24154.3 17286.6	22087.5 15807.7	13.72 9.82
NANTUCKET SOUND.								
Hyannis	41 37 51.17	70 18 05.25	27 43 49 81 57 16	Sampson's Hill..... Falmouth.....	207 36 47 261 44 53	34722.1 28616.3	31751.2 26168.0	19.73 16.26
Nantucket Cliff.....	41 17 33.56	70 06 32.29	108 00 24 156 04 16	Indian Hill..... Shootflying Hill.....	287 38 04 335 55 02	54116.0 52128.1	49485.7 47667.9	30.75 29.62
Great Point Light.....	41 23 22.10	70 02 24.55	28 12 04 88 05 38	Nantucket Cliff..... Sampson's Hill.....	208 09 20 267 48 16	13338.4 40080.4	12197.1 36651.0	7.58 22.77
Sankaty Head.....	41 16 57.66	69 57 31.89	95 04 58 150 10 57	Nantucket Cliff..... Great Point Light.....	274 59 01 330 07 44	13802.9 14951.3	12621.9 13672.0	7.84 8.50
Squamp Head.....	41 19 31.24	69 59 34.52	50 59 21 69 33 15	Great Point Light..... Nantucket Cliff.....	330 57 29 249 28 39	8906.4 11343.5	8144.3 10372.9	5.06 6.45
Gibbs' Pond	41 16 51.38	70 01 09.94	267 47 50 99 52 05	Sankaty Head..... Nantucket Cliff.....	87 50 14 279 48 32	5552.2 8324.0	5077.2 7611.8	3.15 4.73

United States Coast Survey.—Geographical Positions. Section 1.—Nantucket Sound. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Forked Pond.....	41 14 13.68	70 00 42.12	221 10 51 172 25 19	Sankaty Head..... Gibbs' Pond.....	41 12 57 352 25 01	6722.3 4907.6	7351.4 5366.8	4.18 3.05
Coatue.....	41 19 04.36	70 02 35.55	298 55 42 334 05 29	Sankaty Head..... Gibbs' Pond.....	118 59 02 154 06 26	8073.0 4559.8	8828.4 4986.5	5.02 2.83
Weeweeder Pond.....	41 14 33.01	70 05 16.42	233 19 40 275 18 33	Gibbs' Pond..... Forked Pond.....	53 22 23 95 21 34	7150.7 6414.4	7819.8 7014.5	4.44 3.99
Windmill Range.....	41 16 37.95	70 06 28.09	298 53 40 336 35 24	Forked Pond..... Weeweeder Pond.....	118 57 28 156 36 11	9200.8 4199.4	10061.7 4592.4	5.72 2.61
Nantucket (Mitchell's house.)	41 16 57.19	70 05 39.00	62 32 34 132 08 09	Windmill Range..... Nantucket Cliff.....	242 32 02 312 07 34	1286.8 1671.9	1407.3 1828.3	0.80 1.04
Nantucket, (South towered church.)	41 16 54.45	70 05 36.39	353 51 24 269 27 12	Weeweeder Pond..... Sankaty Head.....	173 51 35 89 32 32	4388.1 11278.5	4798.7 12333.8	2.73 7.01
Sankaty Head Light.....	41 16 59.13	69 57 35.09	150 21 27 89 18 27	Great Point Light..... Nantucket, (South towered church.)	330 18 16 269 13 09	13595.7 11204.4	14867.8 12252.8	8.45 6.96
Clark's Cove.....	41 15 18.19	70 10 21.69	281 04 08 245 37 58	Weeweeder Pond..... Windmill Range.....	101 07 29 65 40 32	7242.1 5967.6	7919.7 6526.0	4.50 3.71
North Pond.....	41 17 36.14	70 10 10.69	3 26 44 289 05 41	Clark's Cove..... Windmill Range.....	183 26 37 109 08 08	4262.8 5481.5	4661.7 5994.4	2.65 3.41
Further Creek.....	41 16 37.44	70 13 45.40	297 15 31 250 03 32	Clark's Cove..... North Pond.....	117 17 45 70 05 54	5334.1 5313.6	5833.3 5810.8	3.31 3.30
Muskeget Island.....	41 20 11.83	70 17 37.04	287 27 57 294 47 07	Nantucket Cliff..... North Pond.....	107 35 16 114 52 02	16212.2 11437.8	17729.2 12508.0	10.07 7.11

United States Coast Survey.—Geographical Positions. Section I.—Nantucket Sound. Sketch A.

186

S. Dec. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Tuckanuck Telegraph.....	41 18 12.24	70 14 47.02	275 52 30 113 06 57	Nantucket Cliff..... Sampson's Hill.....	95 57 57 292 57 46	11570.6 21071.7	12653.2 23043.4	7.19 13.09
Nantucket Light Boat.....	41 26 44.00	70 17 05.00	319 02 .. 176 07 ..	Nantucket Cliff..... Hyannis.....	139 10 .. 356 07 ..	22461.0 20627.0	24563.0 22557.0	13.96 12.82
Cotuit Neck.....	41 35 28.97	70 26 22.88	249 06 42 7 42 27	Hyannis..... Sampson's Hill.....	69 12 12 187 40 55	12327.4 23949.1	13480.8 26190.0	7.66 14.88
Hamblin's Hill.....	41 41 47.77	70 23 52.27	58 25 29 312 14 51	Falmouth..... Hyannis.....	238 16 56 132 18 42	20981.0 10849.7	22944.2 11864.9	13.04 6.74
Marston Mills.....	41 38 47.53	70 24 35.73	233 23 08 190 12 46	Shootflying Hill..... Hamblin's Hill.....	53 25 51 10 13 15	7124.0 5650.6	7790.5 6179.3	4.42 3.51
Osterville.....	41 37 49.98	70 22 35.74	269 38 26 166 26 23	Hyannis..... Hamblin's Hill.....	89 41 26 346 25 32	6260.5 7546.2	6846.3 8252.3	3.89 4.68
Osterville Spire.....	41 37 39.91	70 22 47.92	266 56 10 80 13 33	Hyannis..... Falmouth.....	86 59 18 260 04 18	6551.5 19650.3	7164.5 21489.0	4.07 12.21
Osterville Point.....	41 36 59.96	70 21 49.30	253 02 17 145 08 36	Hyannis..... Osterville.....	73 04 46 325 08 05	5421.3 1880.7	5928.6 2056.7	3.37 1.17
Collier's Ledge.....	41 35 46.18	70 20 45.29	146 12 20 223 50 40	Osterville..... Hyannis.....	326 11 07 43 52 26	4596.0 5347.2	5026.1 5847.5	2.86 3.32
Bishop and Clerks.....	41 34 25.27	70 14 40.56	143 17 20 119 53 51	Hyannis..... Osterville.....	323 15 04 299 48 35	7924.8 12686.0	8666.3 13873.0	4.92 7.88
Point Gammon Light.....	41 36 32.80	70 15 38.81	59 54 45 35 17 30	Indian Hill..... Sampson's Hill.....	239 38 24 215 08 50	39726.7 31461.8	43443.9 34405.7	24.68 19.55

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Point Gammon.....	° ' " 41 37 02.81	° ' " 70 15 17.91	° ' " 207 35 11 126 30 15	German Hill..... Hamblin's Hill.....	27 37 13 306 24 33	9156.3 14796.0	10013.1 16180.5	5.69 9.19
CAPE COD AND CAPE COD BAY.								
German's Hill	41 41 25.89	70 12 14.49	50 48 57 92 28 13	Hyannis..... Hamblin's Hill.....	230 45 04 272 20 29	10472.9 16148.0	11452.8 17658.9	6.50 10.03
Centreville Church.....	41 38 42.80	70 20 27.95	179 51 32 295 44 27	Shootflying Hill..... Hyannis.....	359 51 31 115 46 02	4393.0 3664.4	4804.1 4007.3	2.73 2.28
Hyannis Spire.....	41 39 03.62	70 16 53 83	127 06 00 36 30 27	Shootflying Hill	307 03 37 216 29 40	6220.5 2779.9	6802.6 3040.0	3.86 1.73
West Yarmouth Spire	41 38 56.94	70 13 25.26	112 03 16 72 38 30	Shootflying Hill..... Hyannis	291 58 35 252 35 25	10555.6 6789.0	11543.3 7424.3	6.56 4.22
Bass River	41 38 36.31	70 11 50.64	59 00 11 173 58 42	Point Gammon..... German's Hill.....	238 57 53 353 58 26	5593.6 5259.4	6120.3 5751.5	3.48 3.27
Bass Hole.....	41 42 47.89	70 13 54.07	70 52 42 317 41 48	Shootflying Hill..... German's Hill.....	250 48 20 137 42 54	9649.7 3421.1	10552.6 3741.2	6.00 2.13
Barnstable Light.....	41 43 19.01	70 16 31.92	52 57 39 74 35 21	Shootflying Hill..... Hamblin's Hill.....	232 55 02 254 30 28	6849.9 10561.7	7490.8 11550.0	4.26 6.56
Barnstable, (cupola).....	41 42 13.09	70 18 41.83	49 36 39 83 49 28	Shootflying Hill	229 36 29 263 46 01	3233.4 7220.4	3536.0 7896.0	2.01 4.49
Barnstable (Unitarian spire)	41 42 00.30	70 17 36.28	66 52 38 87 29 40	Shootflying Hill	246 50 44 267 25 30	4326.8 8702.6	4731.7 9516.9	2.69 5.41

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Barnstable	41 41 46.75	70 18 04.25	00 11 56 69 15 11	Hyannis..... Shootflying Hill.....	180 11 55 248 59 12	7265.0 3571.0	7944.8 3905.1	4.51 2.22
Barnstable (west spire)	41 41 52.74	70 22 41.93	295 24 03 84 08 02	Shootflying Hill..... Hamblin's Hill.....	115 25 32 264 37 16	3419.0 1634.2	3738.9 1787.1	2.13 1.02
Provincetown.	42 03 06.41	70 10 59.11	17 54 16 67 31 32	Shootflying Hill..... Manomet Hill	197 47 54 247 15 24	42820.9 36094.7	46827.6 39472.1	26.61 22.43
Scargo Hill.....	41 44 20.33	70 10 28.37	121 35 15 178 50 07	Manomet Hill	301 18 49	39985.2	43726.6	24.84
Griffin's Island.....	41 56 12.30	70 03 44.54	23 01 22 141 59 11	Provincetown.	358 49 47	34746.0	37997.2	21.59
Mill Hill	41 46 32.02	69 59 45.39	162 53 55 74 45 45	Scargo Hill..... Provincetown.	202 56 53 321 54 20	23857.8 16224.0	26090.2 17742.1	14.82 10.08
Chatham.	41 41 48.53	69 53 26.78	105 45 06 168 16 29	Griffin's Island..... Scargo Hill.....	342 51 15 254 38 37	18731.8 15397.5	20484.5 16838.2	11.64 9.57
Yarmouth Port (spire).....	41 42 22.77	70 14 15.70	302 02 42 235 20 24	Scargo Hill..... Mill Hill	285 37 05 348 15 36	17322.7 8931.9	18943.6 9767.7	10.76 5.55
North Dennis.....	41 44 40.22	70 12 08.33	284 46 15 1 21 45	German's Hill	122 04 02 55 22 55	3305.5 6386.3	3614.8 6983.9	2.05 3.97
North Dennis (white spire) ..	41 44 44.89	70 11 02.23	124 56 50 255 41 02	Scargo Hill..... German's Hill	104 47 22 181 21 44	2389.6 5995.6	2613.2 6556.6	1.49 3.73
North Dennis (gray spire)...	41 44 42.89	70 11 00.44	122 33 46 256 34 55	North Dennis..... Scargo Hill.....	304 56 13 75 41 31	1533.6 1087.2	1677.1 1188.9	0.95 0.68
				North Dennis..... Scargo Hill.....	302 33 08 76 35 23	1570.3 1014.8	1717.2 1109.8	0.98 0.63

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.			Distance.	Distance.	Distance.
					°	'	"			
Sursuit Creek	41 45 32.29	70 08 07.07	55 49 44 73 56 38	Scargo Hill..... North Dennis.....	235	48	11 253 53 57	3943.7 5799.3	4312.7 6341.9	Miles. 2.45 3.60
Monomoy	41 35 35.39	69 58 41.50	96 45 31 119 57 47	Point Gammon..... German's Hill	276	34	30 299 48 47	23221.4 21693.5	25394.2 23723.4	14.43 13.48
Monomoy Light.....	41 33 32.79	69 59 18.98	129 11 04 184 31 48	German's Hill	309	02	29	23130.3	25294.6	14.37
South Dennis	41 39 04.47	70 07 50.82	70 06 10 296 50 48	Chatham	4	32	23	15341.4	16776.9	9.53
South Dennis (north spire) ..	41 40 32.12	70 09 02.91	93 44 53 53 22 19	Point Gammon..... Monomoy	250	01	13 116 56 53	11004.2 14254.1	12033.9 15587.9	6.84 8.86
South Dennis (south spire) ..	41 40 19.50	70 09 12.07	95 07 23 55 07 23	Shootflying Hill	273	37	19	15882.7	17368.9	9.87
Herring River Spire.....	41 49 10.87	70 06 40.95	95 04 57 64 10 07	Point Gammon.....	233	18	10	10794.9	11805.0	6.71
Harwich Port	41 39 49.18	70 03 44.87	72 18 57 318 05 15	Shootflying Hill	275	00	48	15932.4	17423.2	9.90
Morris' Island	41 39 27.39	69 57 12.25	94 16 09 16 06 30	Point Gammon..... Monomoy	235	03	13	10602.6	11594.7	6.59
West Chatham.....	41 40 07.32	70 01 20.41	282 05 16 336 18 45	Shootflying Hill	274	55	48	19206.1	21003.2	11.93
Chatham Spire.....	41 41 00.70	69 57 18.11	133 04 11 357 18 48	Point Gammon..... Monomoy	244	04	24	13292.3	14536.1	8.26
				Point Gammon..... Monomoy	252	11	15 138 08 36	16834.7 10514.3	18409.9 11498.1	10.46 6.53
				Harwich Port	274	11	50	9105.3	9957.3	5.66
				Monomoy	196	05	31	7447.8	8144.7	4.63
				Morris' Island	102	08	01	5870.1	6419.4	3.65
				Monomoy	156	20	30	9157.8	10014.7	5.69
				Chatham.....	313	03	25	2165.6	2368.2	1.35
				Morris' Island	177	18	48	2881.6	3151.2	1.79

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Chatham, (Congregational belfry.)	41 41 13.89	69 57 56.57	147 06 46 342 40 39	Chatham Morris' Island	327 06 26 162 41 08	1276.2 3441.2	1395.6 3763.2	0.79 2.14
Chatham South Light.....	41 40 14.84	69 56 36.93	138 41 08 87 45 11	Chatham West Chatham.....	318 39 58 267 42 02	3815.6 6546.4	4172.6 7159.0	2.37 4.07
Indian Brook.....	41 51 28.26	70 00 01.87	47 40 05 357 36 51	Scargo Hill Mill Hill	227 33 08 177 37 02	19581.5 9146.5	21413.8 10002.3	12.17 5.68
Eastham.....	41 49 23.98	69 59 53.34	358 01 05 57 29 15	Mill Hill Scargo Hill.....	178 01 10 237 22 12	5308.0 17399.5	5804.7 19027.6	3.30 10.81
Brewster.....	41 46 10.64	70 04 24.94	226 24 19 264 08 29	Eastham Mill Hill	46 27 20 84 11 35	8653.5 6489.3	9463.2 7096.5	5.38 4.03
Orleans.....	41 47 30.34	70 00 29.93	330 14 44 65 38 50	Mill Hill Brewster.....	150 15 14 245 36 13	2072.3 5957.6	2266.2 6515.1	1.29 3.70
Nausett Harbor.....	41 47 20.60	69 56 25.21	72 03 25 146 49 14	Mill Hill Indian Brook	252 01 12 326 46 49	4858.8 9139.1	5313.5 9984.4	3.02 5.67
Nausett Lights, (station south of.)	41 51 08.79	69 56 38.94	357 25 20 26 45 50	Nausett Harbor..... Mill Hill	177 25 30 206 43 45	7047.0 9561.2	7706.4 10455.8	4.38 5.94
Nausett Centre Light.....	41 51 36.54	69 56 43.82	7 28 38 54 49 01	Chatham Scargo Hill.....	187 27 29 234 39 51	18294.8 23310.0	20006.6 25491.1	11.37 14.48
Griffin's Island.....	41 56 12.30	70 03 44.54	23 01 22 141 59 11	Scargo Hill..... Provincetown	202 56 53 321 54 20	23857.8 16224.0	26090.2 17742.1	14.82 10.08
Billingsgate Point Light.....	41 51 36.70	70 03 55.20	328 27 18 34 01 29	Mill Hill Scargo Hill.....	148 30 04 213 57 07	11026.2 16235.1	12057.9 17754.2	6.85 10.09

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod and Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	
						Metres.	Yards.
Eastham, (Congregational spire.)	41 50 26.14	69 58 32.81	243 22 09 44 05 59	Nausett Lights, (station S. of) Eastham	63 23 25 224 05 06	2938.4 2671.1	3213.4 2921.0
Orleans, (Orthodox spire)...	41 47 02.75	69 58 08.56	2 42 09 155 28 10	Pleasant Bay	182 42 03	4632.9	5066.4
				Griffin's Island	335 24 23	18640.3	20384.5
Nausett Beach	41 44 03.46	69 55 12.58	126 03 09 164 35 08	Mill Hill	306 06 07	7792.0	8521.1
				Nausett Harbor	344 34 20	6308.5	6898.8
Pleasant Bay	41 44 32.73	69 58 18.04	281 52 29 2 16 53	Nausett Beach	101 54 33	4378.5	4788.2
				Chatham	182 16 48	5070.1	5544.5
Blackfish Creek	41 54 26.78	70 00 43.27	35 52 22 127 56 51	Scargo Hill	215 45 51	23071.7	25230.5
				Griffin's Island	307 54 50	5295.9	5791.4
South Wellfleet, (Congrega- tional spire.)	41 54 30.00	69 58 45.56	87 55 26 40 50 07	Blackfish Creek	267 54 08	2714.6	2968.6
				Scargo Hill	220 42 19	24834.7	27158.5
Lombard Head	41 55 49.60	69 58 29.46	50 21 55 95 32 32	Blackfish Creek	230 20 26	4004.0	4378.7
				Griffin's Island	275 29 01	7292.4	7974.8
Hamblin's Mound	41 56 12.14	70 02 25.95	277 15 10 323 56 27	Lombard Head	97 17 48	5491.8	6005.7
				Blackfish Creek	143 57 36	4020.0	4396.2
North Wellfleet, (Methodist belfry.)	41 56 17.59	70 01 27.45	343 25 18 29 28 18	Blackfish Creek	163 25 48	3566.3	3900.0
				Scargo Hill	209 22 18	25403.3	27780.3
North Wellfleet, (Congrega- tional belfry.)	41 56 07.58	70 00 54.96	355 03 26 31 16 57	Blackfish Creek	175 03 34	3129.7	3412.7
				Scargo Hill	211 10 34	25515.3	27902.8
Cambria	41 59 12.84	70 00 23.52	337 15 41 26 50 07	Lombard Head	157 16 57	6789.0	7424.3
				Hamblin's Mound	206 48 45	6246.9	6831.4

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Pamet	42 00 12.85	70 04 31.19	287 58 18 351 45 46	Cambria	108 01 04	5992.2	6552.9	3.72
				Griffin's Island	171 46 17	7498.6	8200.3	4.66
Highland	42 01 39.29	70 02 25.99	10 19 21 162 52 45	Griffin's Island	190 09 29	10248.5	11207.5	6.37
				Provincetown	282 47 01	12162.9	13235.4	7.52
Highland Light	42 02 21.17	70 03 18.35	325 17 33 3 02 06	Cambria	145 19 50	7066.3	7727.5	4.39
				Griffin's Island	183 01 49	11395.1	12461.3	7.08
Truro, (Congregational spire).	41 59 52.02	70 02 56.95	106 31 27 9 11 20	Pamet	286 30 24	2262.2	2473.9	1.40
				Griffin's Island	189 10 49	6866.9	7509.4	4.27
Long Point Light	42 01 57.08	70 09 47.44	321 49 38 293 48 51	Griffin's Island	141 53 41	13523.9	14789.3	8.40
				Pamet	113 52 23	7954.6	8698.9	4.94
Stout	42 04 07.49	70 07 11.38	341 59 51 333 00 43	Griffin's Island	162 02 09	15412.9	16855.1	9.58
				Pamet	153 02 31	8122.8	8882.9	5.05
Race Point	42 04 48.38	70 12 05.27	280 33 00 334 11 59	Stout	100 36 17	6871.4	7514.4	4.27
				Provincetown	154 12 43	3494.1	3821.0	2.17
Race Point Light	42 03 42.30	70 14 15.59	235 45 23 313 39 16	Race Point	55 46 51	3623.7	3962.8	2.25
				Griffin's Island	133 46 19	20089.1	21968.8	12.48
Provincetown, (new Univer- salist spire.)	42 03 00.05	70 10 58.53	321 31 00 176 20 22	Griffin's Island	141 35 51	16061.3	17564.2	9.98
				Provincetown	356 20 22	197.3	215.8	0.12
Provincetown, (Orthodox spire.)	42 03 02.10	70 10 56.17	321 47 56 153 31 18	Griffin's Island	141 52 45	16075.5	17579.7	9.99
				Provincetown	333 31 16	151.9	166.1	0.09
Provincetown, (Methodist belfry.)	42 03 04.49	70 10 56.39	321 57 17 133 42 33	Griffin's Island	142 02 06	16138.6	17648.7	10.03
				Provincetown	313 42 32	86.3	94.4	0.05

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Miles.	
Provincetown, (old Universalist belfry.)	42 02 49.01	70 11 05.58	195 28 50 320 17 31	Provincetown	15 28 55	609.5	0.35	
Provincetown	42 03 06.41	70 10 59.11	17 54 16 67 31 32	Shootflying Hill	140 22 26	17387.2	9.88	
				Manomet Hill	197 47 54	46827.6	26.61	
					247 15 24	39472.1	22.43	
CAPE COD BAY.								
Peaked Cliff.....	41 48 29.27	70 32 03.77	162 15 33 310 23 28	Manomet Hill	342 13 31	15137.9	8.60	
				Shootflying Hill	130 31 11	23089.3	13.12	
Scorton Neck.....	41 44 16.99	70 24 19.82	126 02 17 144 36 28	Peaked Cliff	305 57 08	14481.6	8.23	
				Manomet Hill	324 29 17	28145.9	15.99	
Scorton Hill.....	41 43 15.11	70 23 20.06	315 15 42 111 45 20	Shootflying Hill	135 17 36	6169.2	3.51	
				Mount Schaum.....	291 40 34	11657.8	6.62	
Mount Schaum	41 45 22.96	70 30 28.67	159 06 05 283 23 52	Peaked Cliff	339 05 01	6728.5	3.82	
				Scorton Neck.....	103 27 57	9580.8	5.44	
Spring Hill Academy	41 44 56.72	70 27 15.24	286 48 37 100 17 06	Scorton Neck.....	106 50 34	4630.5	2.63	
				Mount Schaum.....	280 14 58	4966.1	2.82	
Sandwich, (Orthodox spire)...	41 45 26.22	70 29 39.14	286 06 51 84 58 47	Scorton Neck.....	106 10 29	8398.5	4.77	
				Mount Schaum.....	264 58 14	1256.1	0.71	
Holmes' Hill	41 55 24.47	70 32 17.73	358 33 35 95 30 15	Peaked Cliff	178 33 44	14011.7	7.96	
				Manomet Hill	275 28 22	4280.9	2.43	
Monk's Hill	41 57 37.01	70 43 02.21	288 41 56 334 59 54	Manomet Hill	108 47 14	12642.6	7.18	
				Pine Hill.....	155 06 11	33786.7	19 20	

United States Coast Survey.—Geographical Positions. Section I.—Cape Cod Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Gurnet	42 00 09.34	70 35 44.82	354 04 09 65 01 16	Manomet Hill	174 04 35	8459.0	9250.5	5.26
				Monk's Hill	244 56 23	11110.5	12150.0	6.90
Plymouth	41 57 22.70	70 39 46.72	95 37 26 296 53 43	Monk's Hill	275 35 16	4523.1	4946.3	2.81
				Manomet Hill	116 56 50	7229.1	7905.5	4.49
Kingston	41 58 51.22	70 41 33.44	303 57 41 318 00 37	Monomet Hill	124 02 00	10737.4	11472.1	6.67
				Plymouth	138 01 48	3673.5	4017.2	2.28
Eel River Steeple	41 56 13.10	70 37 27.89	289 05 54 108 37 03	Manomet Hill	109 07 29	3438.0	3759.7	2.14
				Monk's Hill	288 33 20	8123.0	8883.0	5.05
Pier Head, Plymouth harbor.	41 58 44.43	70 38 52.17	70 09 45 238 42 23	Monk's Hill	250 06 58	7777.5	8505.2	4.83
				Gurnet	58 44 29	5045.1	5517.1	3.14
North Plymouth Rope Works	41 58 45.42	70 40 58.95	250 16 15 53 22 31	Gurnet	70 19 47	7679.4	8397.9	4.77
				Monk's Hill	233 21 09	3536.3	3867.2	2.20
Kingston Spire	41 59 34.02	70 43 31.58	302 10 25 224 09 47	Manomet Hill	122 16 03	13737.0	15022.3	8.54
				Gurnet	84 15 00	10796.6	11806.8	6.71
Gurnet South Light	42 00 10.26	70 35 42.74	64 59 30 331 41 00	Monk's Hill	244 54 37	11165.8	12210.5	6.94
				Holmes' Hill	151 51 17	10000.5	10936.2	6.21
Standish	42 00 48.71	70 40 37.01	280 12 49 29 29 11	Gurnet	100 16 04	6831.8	7471.1	4.25
				Monk's Hill	209 27 33	6792.9	7428.5	4.22
Powder Point	42 02 47.09	70 38 49.55	158 47 22 34 06 02	White	338 45 52	8500.2	9295.6	5.28
				Standish	214 04 50	4409.6	4822.2	2.74
West Duxbury Spire	42 02 04.59	70 41 12.25	324 52 22 295 14 12	Manomet Hill	144 56 27	14628.9	15997.7	9.09
				Gurnet	115 17 51	8329.7	9109.1	5.18

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
East Duxbury Belfry.....	42 02 06.05	70 40 02.84	330 25 01 301 12 56	Manomet Hill Gurnet.....	150 28 20 121 15 49	13811.8 6942.0	15104.2 7591.6	8.58 4.31
MASSACHUSETTS BAY.								
Webster's Flagstaff.....	42 04 37.18	70 39 52.57	338 27 34 325 23 20	Manomet Hill Gurnet.....	158 30 47 145 26 08	17926.1 10036.9	19603.4 10976.1	11.14 6.24
Dan. Webster's West Chimney.	42 04 46.23	70 40 25.89	328 55 03 168 31 34	Powder Point..... White.....	148 56 08 348 31 08	4291.3 4334.8	4692.8 4740.4	2.67 2.69
Brant.....	42 05 15.28	70 38 07.48	340 49 06 346 52 50	Gurnet..... Manomet Hill.....	160 50 42 166 54 51	9992.7 18329.5	10927.7 20044.6	6.21 11.39
White	42 07 03.92	70 41 03.43	330 10 16 338 50 12	Gurnet..... Manomet Hill.....	150 13 49 158 53 11	14739.1 22735.0	16118.2 24862.3	9.16 14.13
Carolina Hill.....	42 06 56.48	70 43 31.67	319 26 31 330 58 57	Gurnet..... Manomet Hill.....	139 31 44 151 04 35	16521.5 23974.7	18067.4 26218.0	10.27 14.90
Sprague's Hill.....	42 00 15.81	70 57 39.02	237 31 31 283 33 41	Carolina Hill Monk's Hill.....	57 40 59 103 43 27	23071.2 20768.4	25230.0 22711.7	14.34 12.90
Lewis.....	42 08 07.44	70 42 52.55	347 01 28 308 00 39	Standish White.....	167 02 59 128 01 52	13889.0 3181.1	15188.6 3478.8	8.63 1.98
Third Cliff.....	42 10 47.81	70 42 40.81	3 07 08 342 03 19	Lewis..... White.....	183 07 01 162 04 25	4954.9 7259.7	5418.5 7939.0	3.08 4.51
Hatch	42 08 06.47	70 41 50.21	330 53 30 166 52 04	White..... Third Cliff.....	150 54 01 346 51 30	2208.5 5111.1	2415.2 5589.4	1.37 3.18

United States Coast Survey.—Geographical Positions. Section 1.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Briggs.....	42 10 00.50	70 44 36.20	325 41 29 312 41 48	Lewis..... Hatch.....	145 42 39 132 43 39	4222.4 5186.3	4617.5 5671.6	2.62 3.22
North Marshfield, (Unitarian spire.)	42 08 28.15	70 44 08.34	281 53 32 167 21 13	Hatch..... Briggs.....	101 55 05 347 20 54	3241.5 2920.2	3544.8 3193.4	2.01 1.81
Nantasket.....	42 18 13.69	70 53 59.10	59 22 50 202 50 24	Blue Hill..... Thompson's Hill.....	239 14 24 22 57 30	20054.9 37053.6	21931.4 40520.7	12.46 23.02
Prospect Waltham.....	42 23 16.85	71 14 54.38	329 30 17 287 54 55	Blue Hill..... Nantasket.....	149 35 56 108 09 01	22722.7 30213.1	24848.9 33040.1	14.12 18.77
Nahant.....	42 25 02.81	70 53 57.13	37 09 08 0 12 17	Blue Hill..... Nantasket.....	217 00 40 180 12 15	28652.0 12621.8	31333.0 13802.8	17.80 7.84
Prospect Hingham.....	42 11 32.67	70 51 06.04	171 06 20 162 14 23	Nahant..... Nantasket.....	351 04 25 342 12 26	25299.6 12993.1	27666.9 14208.9	15.72 8.07
Powderhorn.....	42 24 02.72	71 01 30.96	18 10 39 259 49 35	Blue Hill..... Nahant.....	198 07 16 79 54 42	22103.6 10540.3	24171.8 11526.6	13.73 6.55
Dorchester Heights.....	42 20 01.45	71 02 14.85	23 28 37 230 43 03	Blue Hill..... Nahant.....	203 25 44 50 48 39	14781.3 14699.6	16164.4 16075.0	9.18 9.13
Deer Island.....	42 20 59.31	70 57 09.90	40 02 10 133 28 56	Blue Hill..... Powderhorn.....	219 55 52 313 26 00	20027.0 8227.2	21900.9 8997.0	12.44 5.11
Corey's Hill.....	42 20 31.39	71 07 41.19	232 22 35 277 01 13	Powderhorn..... Dorchester Heights.....	52 26 44 97 04 51	10688.9 7526.5	11689.1 8230.8	6.64 4.68
White's Hill.....	42 12 50.45	70 58 18.21	283 34 03 157 50 16	Prospect Hingham..... Dorchester Heights.....	103 38 53 337 47 37	10199.7 14360.0	11154.1 15703.7	6.34 8.92

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
East Weymouth Church.....	42 12 48.39	70 55 09.97	292 38 11 90 51 49	Prospect Hingham White's Hill.....	112 40 55 270 49 43	6063.5 4317.7	6630.9 4721.7	3.77 2.68
North Weymouth Church ...	42 13 44.45	70 56 21.85	201 29 03 58 02 25	Nantasket..... White's Hill.....	21 30 38 238 00 47	8928.9 3144.8	9764.4 3439.1	5.55 1.95
Weymouth, (flag on Great Hill.)	42 14 57.37	70 56 12 40	36 23 22 206 44 47	White's Hill..... Nantasket.....	216 22 00 26 46 17	4863.6 6783.6	5318.7 7418.4	3.02 4.22
Weymouth, (pole on King Oak Hill.)	42 13 36.91	70 56 04.24	198 33 08 144 26 36	Nantasket..... Dorchester Heights	18 34 32 324 22 25	9008.4 14589.2	9851.3 15954.3	5.60 9.07
Scituate Hill.....	42 14 12.64	70 49 30.08	140 22 19 24 02 19	Nantasket..... Prospect Hingham	320 19 18 204 01 15	9359.7 5403.9	10563.6 5909.5	6.00 3.36
Hayden's Hotel.....	42 15 08.37	70 45 58.96	46 38 46 117 28 55	Prospect Hingham Nantasket.....	226 35 19 297 25 12	9388.7 12397.7	10595.3 13557.8	6.02 7.70
Great Quincy.....	42 16 27.03	70 56 45.78	229 13 28 319 20 53	Nantasket..... Prospect Hingham	49 15 20 139 24 41	5040.7 11964.5	5512.4 13084.0	3.13 7.43
Crow Point.....	42 15 39.98	70 53 25.37	170 44 54 337 16 02	Nantasket..... Prospect Hingham	350 44 32 157 17 36	4805.2 8272.0	5254.8 9046.0	2.99 5.14
Quincy, (stone church).....	42 15 02.24	70 59 51.89	160 28 59 298 09 03	Dorchester Heights Prospect Hingham	340 27 23 118 14 56	9795.0 13682.7	10711.5 14963.0	6.09 8.50
Quincy, (black top church) ..	42 14 58.65	70 59 28.82	233 51 53 337 43 59	Great Quincy..... White's Hill.....	53 53 42 157 44 46	4625.6 4273.6	5058.4 4673.5	2.87 2.66
Quincy, (church at Bent's Point.)	42 14 43.75	70 58 10.86	221 39 47 2 45 45	Nantasket..... White's Hill.....	41 42 37 182 45 40	8673.8 3499.5	9485.4 3827.0	5.39 2.20

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station,	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Hingham, (church on Great Plain.)	42 12 36.34	70 52 43.37	311 19 54 93 16 34	Prospect Hingham White's Hill.....	131 21 00 273 12 49	2973.9 7691.9	3252.2 8411.6	1.85 4.78
Sagamore Head, (signal).....	42 16 22.45	70 51 28.92	91 08 33 134 56 38	Great Quincy Nantasket.....	271 05 00 314 54 57	7262.5 4859.4	7942.1 5314.1	4.51 3.02
Hingham, (new North church.)	42 14 32.32	70 53 08.34	169 24 35 125 23 56	Crow Point Great Quincy.....	349 24 24 305 21 30	2123.6 6111.6	2322.3 6683.5	1.32 3.80
Hingham, (old church).....	42 14 26.70	70 52 53.85	162 17 25 124 57 18	Crow Point Great Quincy.....	342 17 04 304 54 42	2373.4 6483.0	2595.5 7089.6	1.47 4.03
Hingham, (cupola of Old Colony House.)	42 14 49.75	70 52 01.50	128 52 40 194 37 29	Crow Point Sagamore Head.....	308 51 44 14 37 51	2469.1 2956.0	2700.1 3232.6	1.53 1.84
Hingham, (Baker's Hill signal.)	42 14 33.92	70 54 07.37	60 59 34 181 36 00	White's Hill Nantasket.....	240 56 45 1 36 06	6578.2 6783.4	7193.7 7418.1	4.09 4.22
Hingham, (Turkey Hill signal.)	42 14 23.66	70 50 53.11	3 13 01 149 02 03	Prospect Hingham Nantasket.....	183 12 52 328 59 58	5283.8 8278.4	5778.2 9053.0	3.28 5.14
Eaton's Hill (Mount Wal- laston) Flag.	42 15 42.07	70 59 32.36	238 28 16 342 11 37	Nantasket White's Hill.....	58 32 01 162 12 27	8954.3 5560.8	9792.2 6081.1	5.56 3.46
Cat Hill Signal.....	42 13 17.17	70 44 59.14	69 04 13 105 25 37	Prospect Hingham Scituate Hill.....	249 00 08 285 22 35	9011.9 6443.7	9855.1 7046.6	5.60 4.00
Cohasset Church.....	42 14 33.63	70 47 52.87	300 37 07 247 40 11	Cat Hill Signal Hayden's Hotel.....	120 39 04 67 41 28	4629.1 2822.2	5062.2 3086.3	2.88 1.75
Minot's Ledge Light-house..	42 16 09.16	70 45 13.56	356 26 17 58 34 46	Cat Hill Signal Scituate Hill.....	176 26 27 238 31 54	5316.8 6891.9	5814.3 7536.8	3.30 4.28

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance. Metres.	Distance. Yards.	Distance. Miles.
					°	'	"			
Scituate Light.....	42 12 15.26	70 42 37.43	120 27 30 81 11 30	Cat Hill Signal..... Scituate Unitarian Church...	300	25	54 261 09 53	3770.1 3333.8	4122.9 3645.8	2.34 2.07
Scituate, (Unitarian spire)...	42 11 58.68	70 45 01.03	123 50 24 84 33 33	Scituate Hill..... Prospect Hingham.....	303	47	23 264 29 27	7426.0 8412.0	8120.9 9199.1	4.62 5.23
Parker's Hill Signal.....	42 13 43.60	70 46 28.29	194 24 55 57 38 51	Hayden's Hotel..... Prospect Hingham.....	14	25	15 237 35 44	2700.9 7542.8	2953.6 8248.8	1.68 4.69
Forbes.....	42 15 25.85	71 01 17.89	171 16 47 242 42 18	Dorchester Heights..... Nantasket.....	357	16	08 62 47 13	8602.1 11308.2	9407.0 12366.3	5.35 7.03
Paine's Hill Observatory, Braintree.	42 13 59.55	70 59 21.88	135 03 03 218 09 45	Forbes..... Great Quincy.....	315	01	45 38 11 30	3763.0 5788.4	4115.1 6330.0	2.34 3.60
Thayer's Hill, (chimney of yellow house,) Braintree.	42 13 49.47	70 57 49.44	196 42 17 266 22 51	Great Quincy..... Scituate Hill.....	16	43	00 86 28 27	5075.1 11471.3	5550.0 12544.7	3.15 7.13
Grape Island, (flag)	42 16 05.27	70 55 06.10	288 40 13 201 10 19	Crow Point..... Nantasket	108	41	21 21 11 04	2436.6 4248.6	2664.6 4646.1	1.51 2.64
Bunkin Island, (flag)	42 16 49.86	70 53 41.74	80 31 33 171 15 38	Great Quincy..... Nantasket	260	29	34 351 15 26	4274.9 2616.8	4674.9 2861.7	2.66 1.63
Pig Rock Beacon.....	42 16 42.05	70 56 01.55	168 51 00 224 45 24	Deer Island..... Nantasket	348	50	15 44 46 46	8089.6 3982.8	8846.6 4355.5	5.03 2.48
Atlantic House, (chimney)...	42 16 01.01	70 50 31.90	95 23 10 337 01 45	Great Quincy..... Scituate Hill.....	275	18	59 157 02 27	8604.1 3631.2	9409.2 3971.0	5.35 2.26
Cohasset, (Black Rock signal)	42 16 06.54	70 49 07.28	93 29 00 120 25 51	Great Quincy..... Nantasket.	273	23	52 300 22 35	10524.7 7750.9	11509.5 8476.2	6.54 4.79

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.		Distance.		
					°	'	Metres.	Yards.	Miles.
Hangman's Ledge, (sunken beacon.)	42 17 42.76	70 57 18.11	181 46 32	Deer Island.....	1	46 37	6066.9	6634.6	3.78
							8029.9	8781.3	4.99
Squantum.....	42 18 11.91	71 00 20.51	180 37 02	Governor's Island.....	0	37 04	5381.9	5885.5	3.34
							8735.1	9552.5	5.43
Roxbury, (Sargent's observatory.)	42 18 40.75	71 05 20.37	136 39 01	Corey's Hill.....	316	37 27	4695.4	5134.8	2.92
							4923.2	5383.9	3.06
Milton Mills, (tall-spired church.)	42 16 24.51	71 03 46.93	197 28 33	Dorchester Heights.....	17	29 35	7017.3	7673.9	4.36
							4716.8	5158.1	2.93
Milton, (old church).....	42 15 10.33	71 04 29.34	156 05 42	Corey's Hill.....	336	03 33	10836.3	11850.3	6.73
							9495.1	10383.6	5.90
Wellington Hill, (flag)	42 16 57.22	71 05 23.04	154 25 47	Corey's Hill.....	334	24 14	7325.6	8011.1	4.55
							7132.3	7799.7	4.43
Neponset Village, (church) ..	42 17 09.61	71 02 31.83	184 11 18	Dorchester Heights.....	4	11 29	5315.4	5812.8	3.30
							3569.2	3903.2	2.22
Dorchester, (Dr. Codman's church.)	42 17 24.85	71 03 56.95	205 48 42	Dorchester Heights.....	25	49 51	5367.0	5869.2	3.33
							3022.0	3304.8	1.88
Dorchester, (flag on Commercial Point wharf.)	42 17 58.29	71 02 17.18	180 48 10	Dorchester Heights.....	0	48 12	3800.1	4155.7	2.36
							2705.2	2958.3	1.68
Dorchester, (summer-house on hill.)	42 18 07.14	71 04 14.61	217 51 19	Dorchester Heights.....	37	52 39	4467.1	4885.1	2.78
							5363.7	5865.6	3.33
Dorchester, (church with clock.)	42 18 27.61	71 03 24.78	208 56 02	Dorchester Heights.....	28	56 49	3308.0	3617.5	2.06
							2677.8	2928.4	1.66

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Roxbury, (tall-spired church, Jamaica Plains.)	42 18 34.44	71 06 38.36	158 15 58 263 46 26	Corey's Hill Sargent's Observatory.....	338 15 16 83 47 18	3884.3 1796.1	4247.8 1964.2	2.41 1.12
Roxbury, (chimney of laboratory.)	42 19 22.52	71 05 31.94	212 30 33 255 04 39	Powderhorn..... Dorchester Heights.....	32 33 15 75 06 52	10253.8 4669.0	11213.3 5105.9	6.37 2.90
Roxbury, (Doctor Putnam's church.)	42 19 45.82	71 05 03.93	201 33 47 111 20 51	Powderhorn Corey's Hill.....	21 36 11 291 19 05	9304.0 3864.4	10174.6 4226.0	5.78 2.40
Roxbury, (new Unitarian church.)	42 19 40.12	71 04 30.68	109 57 24 258 02 14	Corey's Hill..... Dorchester Heights.....	289 55 15 78 03 46	4638.9 3178.2	5073.0 3475.6	2.88 1.98
Brookline, (Doctor Peirce's church.)	42 19 36.18	71 07 31.47	172 33 40 225 03 14	Corey's Hill..... Powderhorn.....	352 33 34 45 07 17	1717.8 11647.6	1878.5 12737.5	1.07 7.24
Governor's Island.....	42 21 06.33	71 00 17.96	53 12 14 272 52 01	Dorchester Heights..... Deer Island.....	233 10 55 92 54 08	3341.5 4309.4	3654.2 4712.6	2.08 2.68
Moon Head.....	42 18 20.20	70 59 01.99	271 37 42 161 15 34	Nantasket Governor's Island.....	91 41 07 341 14 41	6939.5 5412.4	7588.8 5918.9	4.31 3.36
Pettick's Island, (flag on north end.)	42 18 04.29	70 55 26.49	156 19 51 261 44 11	Deer Island..... Nantasket.....	336 18 42 81 45 09	5895.8 2022.1	6447.5 2211.3	3.66 1.26
George's Island.....	42 19 09.17	70 55 21.22	143 47 57 118 02 51	Deer Island..... Governor's Island.....	323 46 43 297 59 33	4211.3 7694.6	4604.5 8414.6	2.62 4.78
Great Brewster	42 19 59.98	70 53 24.06	109 31 14 90 15 46	Deer Island..... Dorchester Heights.....	289 28 41 270 09 50	5483.4 12150.5	5996.5 13287.4	3.41 7.55
Point Allerton, (flag).....	42 18 35.13	70 52 38.26	158 10 16 70 21 28	Great Brewster..... Nantasket.....	338 09 45 250 20 34	2819.9 1965.8	3083.8 2149.7	1.75 1.22

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Watertown, (flag on Gallop Island.)	42 19 35.32	70 56 00.37	148 27 01 115 29 27	Deer Island..... Governor's Island.....	328 26 14 295 26 34	3040.9 6530.7	3325.4 7141.8	1.89 4.06
Nix's Mate.....	42 19 51.58	70 56 19.84	112 57 29 151 15 58	Governor's Island..... Deer Island.....	292 54 48 331 15 24	5918.2 2383.0	6472.0 2606.0	3.68 1.48
Rainsford Island, (flag-staff)..	42 18 44.84	70 56 46.32	172 35 14 284 04 01	Deer Island..... Nantasket.....	352 34 59 104 05 53	4183.5 3948.0	4575.0 4317.4	2.60 2.45
Long Island, (flag on south end of.)	42 18 37.53	70 58 16.08	277 05 48 148 43 11	Nantasket..... Governor's Island.....	97 08 41 328 41 48	5930.8 5372.3	6485.8 5875.0	3.69 3.34
Long Island Light.....	42 19 46.15	70 57 03.03	44 55 17 93 48 39	Blue Hill..... Dorchester Heights.....	224 48 55 273 45 10	18467.2 7153.8	20195.2 7823.2	11.48 4.44
Deer Island Beacon.....	42 20 21.47	70 56 57.32	106 47 36 166 08 47	Governor's Island..... Deer Island.....	286 45 20 346 08 37	4796.3 1202.3	5245.1 1314.8	2.98 0.75
Boston Light.....	42 19 38.77	70 53 05.06	173 12 38 55 14 32	Nahant..... Blue Hill.....	353 12 02 235 05 30	10067.9 22515.7	11009.9 24622.5	6.26 13.99
Barrel Beacon, (near Boston light.)	42 19 20.29	70 54 48.08	133 16 16 113 27 23	Deer Island..... Governor's Island.....	313 14 41 293 23 41	4457.7 8229.4	4874.8 8999.4	2.77 5.11
Outer Brewster.....	42 20 27.50	70 52 19.98	28 48 29 59 55 44	Nantasket..... Great Brewster.....	208 47 22 239 55 01	4710.8 1695.0	5151.6 1853.6	2.93 1.05
Strawberry Hill, (barn)	42 17 20.53	70 52 28.35	22 51 19 74 23 12	Crow Point..... Great Quincy.....	202 50 41 254 20 19	3365.4 6124.0	3680.3 6697.0	2.09 3.81
Lovell's Island, (pole).....	42 19 46.62	70 55 29.27	261 48 26 324 13 49	Great Brewster..... Nantasket.....	81 49 50 144 14 50	2895.5 3532.7	3166.4 3863.3	1.80 2.20

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
						Metres.	Yards.	Miles.
Spectacle Island, (pole).....	42 19 36.94	70 58 55.59	145 38 54 290 41 31	Governor's Island Nantasket.....	325 37 59 110 44 50	3340.8	3653.4	2.05
						7258.3	7937.5	4.51
Thompson's Island, (flag).....	42 19 12.62	70 59 55.05	115 13 04 171 29 56	Dorchester Heights..... Governor's Island	295 11 30 351 29 40	3537.5	3868.5	2.20
						3547.4	3879.3	2.21
Thompson's Island, (pole near Farm School.)	42 19 05.56	71 00 04.94	120 06 28 12 08 41	Dorchester Heights..... Squantum	300 05 01 192 08 31	3437.7	3759.4	2.14
						1693.6	1852.1	1.05
Green Island, (flag).....	42 21 09.18	70 53 11.95	11 16 48 86 49 04	Nantasket..... Deer Island	191 16 16 266 46 24	5520.6	6037.2	3.43
						5454.0	5964.3	3.39
Graves Signal.....	42 21 51.68	70 51 51.49	154 01 50 23 29 20	Nahant Nantasket.....	334 00 24 203 27 55	6559.6	7173.4	4.08
						7332.1	8018.2	4.56
Bluff Head, (flag).....	42 22 01.86	70 57 43.46	59 08 22 323 51 48	Dorchester Heights..... Nantasket	239 05 21 143 54 21	7237.0	7914.2	4.50
						8713.6	9528.9	5.41
Grover's Cliff.....	42 23 20.83	70 57 47.57	348 59 55 239 08 01	Deer Island Nahant	168 50 20 59 10 37	4450.6	4867.1	2.77
						6137.0	6711.2	3.81
Castle Island	42 20 17.28	71 00 24.59	253 45 31 79 03 12	Deer Island Dorchester Heights.....	73 47 42 259 01 58	4640.7	5074.9	2.88
						2571.0	2811.6	1.60
Point Shirley, (chimney of foundry.)	42 21 29.84	70 57 59.13	65 02 21 77 10 07	Dorchester Heights..... Governor's Island	244 59 30 257 08 33	6456.5	7060.6	4.01
						3258.8	3563.7	2.02
Apple Island, (flag).....	42 21 29.60	70 59 11.37	288 34 19 57 05 19	Deer Island Dorchester Heights.....	108 35 41 237 03 15	2932.6	3207.0	1.82
						5003.2	5471.4	3.11
South Boston Point.....	42 20 11.03	71 01 12.40	216 07 38 176 36 06	Governor's Island Powderhorn	36 08 16 356 35 53	2112.6	2310.3	3.31
						7160.8	7830.8	4.45

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Boston, State House.....	42 21 27.62	71 03 30.00	327 05 44 73 13 59	Dorchester Heights..... Corey's Hill	147 06 35 253 11 02	3163.3 6004.5	3462.6 6566.3	1.97 3.73
Boston, Faneuil Hall	42 21 34.40	71 03 02.68	339 06 28 204 36 51	Dorchester Heights..... Powderhorn	159 07 00 24 37 53	3069.8 5033.8	3357.0 5504.8	1.91 3.13
Bunker Hill Monument	42 22 33.07	71 03 19.52	342 26 33 221 54 12	Dorchester Heights..... Powderhorn	162 27 16 41 55 26	4906.4 3716.8	5365.5 4064.6	3.05 2.31
Boston, Cunard Wharf, (flag- staff.)	42 21 48.10	71 02 05.86	3 35 09 297 33 26	Dorchester Heights..... Governor's Island	183 35 03 117 34 39	3297.0 2784.7	3605.5 3045.3	2.05 1.73
Boston, Long Wharf Station.	42 21 35.67	71 02 32.71	197 17 13 286 21 03	Powderhorn	17 17 55	4751.3	5195.9	2.95
Boston, Battery Wharf.....	42 21 59.33	71 02 38.16	296 59 51 201 59 12	Governor's Island	117 01 26	3600.5	3937.4	2.24
Boston, Cupola Lewis' Wharf	42 21 45.46	71 02 38.96	290 30 06 200 09 48	Powderhorn	21 59 58	4105.3	4489.4	2.55
Boston, Hollis Street Church.	42 20 57.44	71 03 32.08	314 19 35 205 50 53	Governor's Island	110 31 41	3444.8	3767.1	2.14
Boston, Hanover St. Church, (with cock on spire.)	42 21 47.93	71 02 56.38	343 51 28 205 09 18	Powderhorn	20 10 33	4511.4	4933.5	2.80
Boston, Navy-yard.....	42 22 22.00	71 02 45.27	208 40 09 304 41 39	Dorchester Heights..... Powderhorn	134 20 27 25 52 15	2472.0 6352.4	2703.3 6946.8	1.54 3.95
South Boston, (Blind Asylum cupola.)	42 20 05.06	71 02 11.80	187 15 30 234 01 35	Powderhorn	163 51 56 25 10 16	3420.2 4594.8	3740.2 5024.7	2.13 2.86
				Powderhorn	28 40 59	3542.0	3873.4	2.20
				Governor's Island	124 43 18	4099.9	4483.5	2.55
				Powderhorn	7 15 58	7391.5	8083.1	4.59
				Governor's Island	54 02 51	3218.8	3520.0	2.00

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

S. Doc. 3.

205

Name of station.	Latitude. O ' "	Longitude. O ' "	Azimuth. O ' "	To station—	Back azimuth. O ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
East Boston Point, (flag).....	42 21 56.27	71 01 23.71	286 48 50 315 40 49	Deer Island..... Governor's Island.....	106 51 42 135 41 34	6067.9 2153.3	6635.7 2354.8	3.77 1.34
East Boston Station.....	42 22 51.15	71 01 50.68	298 12 55 326 43 40	Deer Island..... Governor's Island.....	118 16 03 146 44 43	7292.3 3867.5	7974.6 4229.4	4.53 2.40
Bird Island Signal.....	42 21 20.79	71 00 54.91	155 24 10 93 24 07	East Boston..... State House.....	335 23 33 273 22 22	3065.7 3555.2	3352.6 3887.9	1.91 2.21
Belle Isle Signal.....	42 22 55.34	70 59 35.29	87 36 43 128 10 05	East Boston..... Powderhorn.....	267 35 12 308 08 47	3100.3 3364.2	3390.4 3679.0	1.93 2.09
Winisimet Village, (church with clock.)	42 23 25.36	71 01 57.13	3 41 23 55 44 39	Dorchester Heights..... Corey's Hill.....	183 41 11 235 40 47	6304.2 9527.4	6894.1 10418.9	3.92 5.92
Waite No. 1.....	42 25 58.87	71 03 36.93	277 22 49 28 57 44	Nahant..... Corey's Hill.....	97 29 20 208 54 59	13365.0 11545.4	14615.6 12625.7	8.30 7.17
Ten Hill Farm.....	42 23 48.92	71 04 54.22	264 44 46 336 08 50	Powderhorn..... State House.....	84 47 03 156 09 47	4667.6 4766.1	5104.3 5212.1	2.90 2.96
Malden Bridge, (chimney of yellow house at toll-gate.)	42 23 32.59	71 03 48.56	253 32 04 183 22 12	Powderhorn..... Waite No. 1.....	73 33 37 3 22 20	3280.9 4520.6	3587.9 4943.6	2.04 2.81
Malden, (tall-spired church with clock.)	42 25 36.88	71 03 40.53	314 25 46 30 18 31	Powderhorn..... Corey's Hill.....	134 27 13 210 15 51	4149.0 10914.9	4537.2 11936.2	2.58 6.78
Somerville, (church on hill.)	42 23 10.19	71 05 31.36	31 14 27 253 33 18	Corey's Hill..... Powderhorn.....	211 12 59 73 36 00	5729.7 5731.8	6265.8 6268.1	3.56 3.56
Somerville, (church near Mal- den bridge.)	42 23 05.45	71 04 15.61	44 43 14 244 50 52	Corey's Hill..... Powderhorn.....	224 40 56 64 52 43	6687.3 4159.3	7313.0 4548.5	4.16 2.58

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Somerville, (stone powder-house.)	42 23 58.44	71 06 39.16	268 53 50 12 31 54	Powderhorn	88 57 17	7048.8	7708.4	4.38
				Corey's Hill	192 31 12	6543.8	7156.1	4.07
Medford, (Unitarian church.)	42 25 12.00	71 06 35.21	287 03 11 9 53 41	Powderhorn	107 06 36	7277.2	7958.1	4.52
				Corey's Hill	189 52 57	8788.3	9610.3	5.46
Cambridgeport, (Universalist church.)	42 21 45.54	71 05 39.86	50 31 30 233 21 01	Corey's Hill	230 30 08	3597.9	3934.6	2.24
				Powderhorn	53 23 49	7093.9	7757.7	4.41
Cambridge, (Unitarian ch.) ..	42 22 26.72	71 06 49.76	247 51 50 18 18 18	Powderhorn	67 55 24	7870.0	8606.4	4.87
				Corey's Hill	198 17 44	3748.0	4098.7	2.33
Cambridge, (Baptist church.)	42 22 32.44	71 06 46.70	18 28 08 248 52 42	Corey's Hill	198 27 31	3937.3	4305.7	2.45
				Powderhorn	68 56 15	7740.0	8464.2	4.81
Cambridge Observ'y, (dome.)	42 22 51.51	71.07 22.88	5 32 17 254 42 02	Corey's Hill	185 32 05	4343.5	4749.9	2.70
				Powderhorn	74 45 59	8343.0	9123.7	5.18
Cambridge, (meridian mark.)	42 25 45.47	71 07 22.53	291 29 30 2 31 27	Powderhorn	111 33 27	8640.0	9448.4	5.37
				Corey's Hill	182 31 14	9699.5	10607.1	6.03
West Cambridge, (church with clock.)	42 24 53.66	71 08 54.84	348 13 58 278 45 44	Corey's Hill	168 14 48	8265.2	9038.6	5.14
				Powderhorn	98 50 43	10270.1	11231.1	6.38
Brighton, (West church with clock.)	42 20 54.26	71 08 59.29	240 24 32 291 32 23	Powderhorn	60 29 35	11789.5	12892.6	7.33
				Corey's Hill	111 33 16	1921.7	2101.5	1.19
Brighton, (East church)	42 20 55.84	71 08 52.03	240 12 49 294 57 09	Powderhorn	60 17 46	11620.9	12708.3	7.22
				Corey's Hill	114 57 57	1788.0	1955.3	1.11
Watertown, United States Arsenal, (flag.)	42 21 40.74	71 09 24.98	247 57 24 312 00 25	Powderhorn	68 02 44	11694.0	12788.2	7.27
				Corey's Hill	132 01 35	3196.7	3595.8	1.99

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Watertown, (skylight of J. P. Cushing's house.)	42 22 46.59	71 09 49.25	258 18 30 324 54 14	Powderhorn Corey's Hill	78 24 05 144 55 40	11635.6 5097.7	12724.4 5574.7	7.23 3.17
Waite No. 2.....	42 26 18.48	71 00 52.08	283 47 24 11 58 58	Nahant Powderhorn	103 52 04 191 58 32	9767.4 4281.9	10681.3 4682.6	6.07 2.66
Ballard's Hill.....	42 27 15.60	70 59 11.51	28 11 15 299 39 53	Powderhorn Nahant	208 09 41 119 43 25	6750.8 8270.5	7382.5 9044.4	4.19 5.14
Chelsea, (village church)....	42 24 31.02	71 00 05.22	19 38 16 65 59 54	Dorchester Heights Powderhorn	199 36 49 245 58 56	8830.1 2146.1	9656.3 2346.9	5.49 1.33
Chelsea, (Cushman's house cupola.)	42 24 57.38	71 00 23.53	201 06 01 309 51 34	Ballard's Hill Grover's Cliff	21 06 49 129 53 19	4570.8 4646.7	4998.5 5081.5	2.84 2.89
Chelsea, (Neptune House flag- staff.)	42 25 41.53	70 58 25.69	348 38 38 54 16 31	Grover's Cliff Powderhorn	168 39 04 234 14 26	4427.4 5218.5	4841.7 5706.8	2.75 3.24
Chelsea, (Crusoe House flag- staff.)	42 26 08.70	70 57 46.52	0 16 01 52 52 34	Grover's Cliff Powderhorn	180 16 00 232 50 03	5179.3 6436.9	5663.9 7039.2	3.22 4.00
Little Nahant.....	42 26 11.31	70 55 30.98	314 33 56 111 30 16	Nahant Ballard's Hill	134 35 00 291 27 48	3011.8 5415.0	3293.5 5921.7	1.87 3.36
Nahant Hotel.....	42 25 07.24	70 53 58.75	50 18 29 79 08 37	Dorchester Heights Powderhorn	230 12 55 259 03 32	14758.2 10528.8	16139.1 11514.0	9.17 6.54
Egg Rock Signal.....	42 25 58.45	70 53 32.26	18 20 11 98 20 06	Nahant Little Nahant	198 19 54 278 18 46	1808.4 2742.8	1977.6 2999.5	1.12 1.71
Lynn, (East church with green tower.)	42 28 05.18	70 55 55.33	45 44 58 334 20 49	Powderhorn Nahant	225 41 12 154 22 10	10714.3 6241.3	11716.8 6825.3	6.66 3.88

United States Coast Survey.—Geographical Positions. Section 1.—Massachusetts Bay. Sketch A.

208

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lynn, (West church turret)...	42 27 43.77	70 57 15.92	71 47 39 5 05 54	Ballard's Hill..... Grover's Cliff.....	251 46 20 185 05 33	2779.9 8144.5	3040.0 8906.6	1.73 5.06
Lynn, (high rock, pole near swing.)	42 28 03.00	70 56 31.04	68 16 01 11 22 12	Ballard's Hill..... Grover's Cliff.....	248 14 13 191 21 20	3947.0 8879.9	4316.3 9710.8	2.45 5.52
Orne's Hill.....	42 30 08.31	70 57 33.37	237 50 40 142 53 13	Thompson's Hill..... Holt's Hill.....	58 00 12 322 47 28	22757.0 19271.9	24886.4 21075.2	14.14 11.97
Coddon's Hill.....	42 30 57.25	70 50 56.39	80 34 57 223 59 43	Orne's Hill..... Thompson's Hill.....	260 30 29 44 04 47	9186.6 14712.0	10046.2 16088.6	5.71 9.14
Folly Hill.....	42 33 57.20	70 54 27.10	31 03 43 319 05 30	Orne's Hill..... Coddon's Hill.....	211 01 37 139 07 53	8241.7 7344.2	9012.9 8031.4	5.12 4.56
Danvers New Mills, (tall spire)	42 33 18.80	70 55 09.45	29 12 46 307 04 40	Orne's Hill..... Coddon's Hill.....	209 11 08 127 07 32	6731.7 7239.6	7361.6 7917.3	4.18 4.50
South Danvers, (spire).....	42 31 33.46	70 55 19.47	49 20 42 280 30 57	Orne's Hill..... Coddon's Hill.....	229 19 11 100 33 56	4029.9 6106.8	4407.0 6678.2	2.50 3.79
Upper Beverly, (spire).....	42 36 28.79	70 50 33.92	39 13 25 48 41 02	Orne's Hill..... Folly Hill.....	219 08 40 228 38 23	15143.3 7080.5	16560.3 7743.0	9.41 4.40
Beverly, (powder-house).....	42 33 10.69	70 52 12.03	52 32 01 337 14 56	Orne's Hill..... Coddon's Hill.....	232 28 22 157 15 47	9242.6 4464.2	10107.4 4881.9	5.74 2.77
Beverly, (spire with turrets).....	42 32 49.17	70 52 22.40	55 04 12 126 26 40	Orne's Hill..... Folly Hill.....	235 00 42 306 25 15	8659.2 3535.4	9469.4 3866.2	5.33 2.20
Manchester Church, (turret)	42 34 28.32	70 45 59.83	63 11 09 46 07 21	Orne's Hill..... Coddon's Hill.....	243 03 16 226 03 59	17741.0 9390.7	19401.0 10269.4	11.02 5.83

United States Coast Survey.—Geographical Positions. Section I.—Massachusetts Bay. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Fort Lee.....	42 31 52.79	70 52 07.83	66 35 00 140 23 57	Orne's Hill..... Folly Hill.....	246 31 19 320 22 22	8099.0 4982.9	8856.8 5449.2	5.03 3.10
Salem, (tall spire).	42 31 10.10	70 53 38.25	70 28 29 276 06 38	Orne's Hill..... Coddon's Hill.....	250 25 50 96 08 27	5695.2 3715.4	6228.1 4063.1	3.54 2.31
Ware's Hill, (flag-staff).....	42 30 38.69	70 54 11.68	78 31 32 262 39 35	Orne's Hill..... Coddon's Hill.....	258 29 12 82 41 47	4698.2 4494.3	5137.9 4914.8	2.92 2.79
Marblehead, (black-top ch.)..	42 30 23.73	70 50 32.98	87 12 23 152 40 52	Orne's Hill..... Coddon's Hill.....	267 07 38 332 40 36	9608.6 1163.9	10507.7 1272.8	5.97 0.72
Marblehead Neck, (flag).....	42 29 45.03	70 50 07.90	94 05 16 153 35 40	Orne's Hill..... Coddon's Hill.....	274 00 15 333 35 07	10195.6 2488.1	11149.6 2720.9	6.34 1.55
Marblehead (Mr. Brookhouse's cupola.)	42 29 06.63	70 52 52.65	106 34 10 217 51 37	Orne's Hill..... Coddon's Hill.....	286 31 00 37 52 56	6686.3 4323.5	7311.9 4728.1	4.16 2.69
Ocean House cupola.....	42 28 51.80	70 52 12.50	107 53 43 204 10 26	Orne's Hill..... Coddon's Hill.....	287 50 06 24 11 18	7697.5 4242.7	8418.0 4639.7	4.78 2.64
Spire made into summer-house	42 28 53.15	70 52 42.35	109 15 31 212 16 51	Orne's Hill..... Coddon's Hill.....	289 12 14 32 18 03	7038.2 4529.9	7696.8 4953.8	4.37 2.82
Lynn, (summer-house on high rock.)	42 28 03.12	70 56 27.76	158 48 40 234 35 31	Orne's Hill..... Coddon's Hill.....	338 47 56 54 39 15	4143.8 9279.8	4531.5 10148.1	2.58 5.77
Legg's Hill.....	42 29 21.38	70 53 09.71	103 33 30 225 48 17	Orne's Hill..... Coddon's Hill.....	283 30 32 45 49 47	6191.8 4244.2	6771.2 4641.3	3.85 2.63
Danvers Plain, (tall spire)....	42 34 01.41	70 55 57.20	309 35 33 273 36 13	Coddon's Hill..... Folly Hill.....	129 38 57 93 37 14	8909.8 2058.9	9743.5 2251.6	5.54 1.28

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Metres.	Miles.
Beverly Point, (flag on tree)...	42 32 57.15	70 53 54.37	43 50 35 158 03 45	Orne's Hill..... Folly Hill.....	223 48 07 338 03 23	7893.6 2184.2	7218.2 1997.3	4.48 1.24
Little Haste Beacon.....	42 32 05.80	70 50 14.81	24 10 05 120 52 20	Coddon's Hill..... Folly Hill.....	204 09 37 300 49 25	2534.9 7330.8	2318.0 6703.5	1.44 4.17
Coney Island, (flag)	42 31 40.97	70 49 53.64	46 43 21 123 59 50	Coddon's Hill..... Folly Hill.....	226 42 38 303 56 45	2151.3 8226.3	1967.2 7522.4	1.22 4.67
Bowditch's Ledge, (beacon)...	42 32 23.46	70 48 22.03	52 57 23 109 11 12	Coddon's Hill..... Folly Hill.....	232 55 39 289 07 04	4827.0 9640.4	4414.0 8815.5	2.74 5.48
North Gooseberry, (flag)	42 31 34.06	70 47 18.00	77 11 05 114 19 24	Coddon's Hill..... Folly Hill.....	257 08 37 294 14 32	5590.3 11744.4	5112.0 10739.5	3.18 6.67
Cat Island, (pole on east rock)	42 30 30.68	70 48 23.84	103 15 37 127 35 09	Coddon's Hill..... Folly Hill.....	283 13 54 307 31 03	3911.9 11432.7	3577.2 10454.5	2.22 6.50
Cat Island, (flag-staff)	42 30 41.59	70 48 34.22	98 29 04 126 53 21	Coddon's Hill..... Folly Hill.....	278 27 28 306 49 22	3587.8 11003.8	3280.8 10062.3	2.04 6.25
CAPE ANN.								
THOMPSON'S HILL.....	42 36 40.03	70 43 27.99	...	.....	...	.....	.....	....
Brown's Hill	42 36 43.80	70 50 28.87	270 39 12 98 31 06	Thompson's Hill	90 43 57	10489.9	9592.3	5.96
Baker's Island Light.....	42 32 09.61	70 46 50.08	208 53 33 75 45 49	Holt's Hill	278 20 34	23550.8	21535.7	13.38
Bolles	42 35 04.05	70 47 14.29	124 46 22 240 07 09	Thompson's Hill	28 55 50	10423.6	9531.7	5.92
				Orne's Hill.....	255 38 34	16569.0	15151.3	9.41
				Brown's Hill	304 44 10	5903.5	5398.4	3.35
				Thompson's Hill	60 09 42	6504.7	5948.1	3.70

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Beverly Rock.....	42 33 56.88	70 49 53.85	171 11 25 240 19 04	Brown's Hill	351 11 02	5211.4 4187.2	5699.0 4579.0	3.24 2.60
Kettle Island.....	42 33 59.38	70 43 00.78	57 05 51 109 03 58	Baker's Island Light..... Bolles	237 03 17 289 01 05	6231.5 6115.6	6814.6 6687.9	3.87 3.80
Halfway Rock Beacon	42 30 07.45	70 46 10.24	103 15 44 211 07 19	Coddon's Hill..... Kettle Island	283 12 31 31 09 27	6710.4 8360.4	7338.3 9142.7	4.17 5.19
Prospect Rowley.....	42 42 17.29	70 53 12.04	307 58 59 14 51 30	Thompson's Hill	128 05 35 194 48 34	16887.2 23266.2	18467.3 25443.2	10.49 14.46
Tilton's Hill.....	42 40 51.29	70 47 13.34	108 02 21 326 28 11	Prospect Rowley..... Thompson's Hill	287 58 17 146 30 44	8584.3 9297.4	9387.5 10167.4	5.34 5.78
Choate's Hill	42 39 53.65	70 45 19.65	112 26 41 336 55 32	Prospect Rowley..... Thompson's Hill	292 21 21 156 56 47	11630.5 6492.5	12718.8 7100.0	7.23 4.04
Butler's Hill.....	42 39 27.63	70 39 57.15	104 36 40 96 16 08	Tilton's Hill..... Choate's Hill	284 31 44 276 12 29	10261.6 7387.6	11221.8 8079.5	6.37 4.59
Railcut Hill	42 37 40.99	70 38 37.21	116 35 30 151 02 46	Tilton's Hill..... Butler's Hill	296 29 40 331 01 53	13139.3 3760.4	14368.8 4012.3	6.49 2.34
Poole's Hill	42 39 22.82	70 37 44.58	57 20 03 20 53 30	Thompson's Hill	237 16 10 200 52 54	9297.0 3362.8	10166.9 3677.5	5.78 2.09
Beacon Hill	42 36 09.86	70 38 17.45	187 10 00 170 54 10	Poole's Hill	7 10 21 350 53 58	6000.3 2847.5	6561.8 3113.9	3.73 1.77
Thatcher's Island	42 38 09.08	70 34 25.06	116 36 50 81 26 47	Poole's Hill	296 34 34 261 23 56	5082.1 5809.6	5557.6 6353.3	3.16 3.61

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Thatcher's Island (south light)	42 38 10.95	70 34 10.46	114 28 09 80 10 19	Poole's Hill Thatcher's Island	294 25 44 269 10 09	5357.3 337.9	5858.6 369.5	3.33 0.21
Thatcher's Island (north light)	42 38 19.42	70 34 09.83	111 49 01 47 24 31	Poole's Hill Thatcher's Island	291 46 32 227 24 21	5268.0 471.4	5760.9 515.5	3.26 0.29
Londoner Spindle	42 38 04.38	70 33 38.13	113 20 36 60 59 25	Poole's Hill Beacon Hill	293 17 49 240 56 16	6113.8 7279.4	6685.9 7960.5	3.80 4.57
Milk Island.....	42 37 39.76	70 35 10.60	56 56 16 228 54 46	Beacon Hill Thatcher's Island	236 54 09 48 55 17	5081.7 1376.4	5556.2 1505.2	3.16 0.86
Straitsmouth Island light.....	42 39 42.50	70 34 57.96	80 55 09 124 25 01	Poole's Hill Andrews' Point	260 53 16 304 23 21	3842.9 4074.3	4202.5 4455.5	2.39 2.53
Andrews' Point	42 40 57.12	70 37 25.60	321 34 17 8 26 58	Thatcher's Island Poole's Hill	141 36 19 188 26 45	6617.1 2941.5	7236.3 3216.7	4.11 1.83
Annis-squam Light	42 39 41.15	70 40 34.10	103 25 45 93 25 14	Tilton's Hill..... Choate's Hill	283 21 14 273 22 01	9344.2 6513.7	10218.5 7123.2	5.81 4.05
Annis-squam Village (pole on rock.)	42 39 25.05	70 40 18.44	97 21 29 324 18 12	Choate's Hill Railcut Hill	277 18 05 144 19 21	6915.6 3952.8	7562.7 4322.7	4.30 2.46
Lane's Cove Church.....	42 40 39.69	70 38 54.66	91 51 14 80 49 48	Tilton's Hill..... Choate's Hill	271 45 36 260 45 27	11358.2 8879.9	12221.0 9710.8	7.06 5.52
Woodward's Hill.....	42 36 57.86	70 41 44.78	207 56 22 287 22 53	Butler's Hill..... Beacon Hill	27 57 36 107 25 12	5231.1 4951.8	5720.6 5415.1	3.25 3.08
Gloucester, (Universalist ch.)	42 36 45.77	70 39 38.95	175 15 20 219 32 29	Butler's Hill..... Railcut Hill	355 15 08 39 33 11	5011.0 2209.5	5479.9 2416.2	3.11 1.37

United States Coast Survey.—Geographical Positions. Section I.—Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	
							Metres.	Yards.
East Gloucester Church	° ' " 42 36 58.57	° ' " 70 39 04.48	° ' " 84 35 06	Thompson's Hill	° ' " 264 32 08	Miles. 3.75	6032.5	6597.0
Clark's Mountain (flag in tree)	° ' " 42 36 57.63	° ' " 70 43 20.00	° ' " 143 37 24	Tilton's Hill	° ' " 323 34 45	5.57	8956.6	9794.7
Twopenny Loaf	° ' " 42 39 34.94	° ' " 70 42 47.75	° ' " 9 38 45	Thompson's Hill	° ' " 189 38 18	3.40	5473.8	5933.0
Lufkin's Hill	° ' " 42 38 14.20	° ' " 70 44 19.71	° ' " 71 41 17	Brown's Hill	° ' " 251 37 07	5.51	8861.7	9690.9
Ipswich East Light	° ' " 42 41 05.68	° ' " 70 45 38.76	° ' " 340 01 01	Thompson's Hill	° ' " 160 02 30	5.42	8720.6	9536.6
Ipswich Spire	° ' " 42 40 51.32	° ' " 70 49 50.60	° ' " 6 30 56	Brown's Hill	° ' " 186 30 30	4.76	7686.4	8495.5
Ipswich West Light	° ' " 42 41 04.94	° ' " 70 45 46.17	° ' " 78 01 24	Tilton's Hill	° ' " 258 00 25	1.26	2028.6	2218.4
Burnham Brown	° ' " 49 39 30 12	° ' " 70 49 04.74	° ' " 225 21 24	Tilton's Hill	° ' " 45 22 39	2.22	3564.5	3893.0
Ten-Pound Island Light	° ' " 42 36 04.78	° ' " 70 39 36.39	° ' " 204 25 43	Raileut Hill	° ' " 24 26 23	2.03	3260.5	3565.6
Salt Island, (flag)	° ' " 42 37 09.52	° ' " 70 37 05.38	° ' " 243 16 44	Thatcher's Island	° ' " 63 18 33	2.54	4088.6	4471.2
Essex, (red top church)	° ' " 42 37 58.08	° ' " 70 46 32.01	° ' " 170 00 59	Tilton's Hill	° ' " 350 00 31	3.37	5426.6	5934.4
				Butler's Hill	° ' " 72 57 38	5.85	9408.9	10239.3

United States Coast Survey.—Geographical Positions. Section I.—Coast North of Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Burnham Essex.....	42 38 59.62	70 46 43.33	314 02 37 168 47 17	Thompson's Hill	134 04 49	6194.2	6773.8	3.85
				Tilton's Hill	348 46 57	3512.7	3841.4	2.18
Dogtown, (Methodist church)	42 38 02.97	70 40 11.91	187 19 52 287 26 41	Butler's Hill.....	7 20 02	2633.4	2879.8	1.64
				Railcut Hill	107 27 45	2261.5	2473.1	1.41
Eastern Point Light	42 34 47.24	70 39 32.72	228 21 44 213 56 21	Thatcher's Island	48 25 12	9378.3	10255.8	5.83
				Beacon Hill	33 57 12	3072.9	3360.4	1.91
Rockport, (church with red top.)	42 39 26.93	70 36 48.51	163 07 12 306 18 36	Andrews' Point	243 06 47	2908.1	3180.2	1.81
				Thatcher's Island	126 20 13	4055.4	4434.9	2.52
Salvages	42 40 18.38	70 33 44.74	103 23 44 72 35 45	Andrews' Point	283 21 14	5168.4	5652.0	3.21
				Poole's Hill	252 33 03	5724.1	6259.7	3.56
COAST OF MASSACHUSETTS NORTH OF CAPE ANN.								
Powow Hill.....	42 51 55.18	70 55 57.76	328 48 02 28 57 37	Thompson's Hill	148 56 31	32985.6	36072.1	20.50
				Holt's Hill	208 50 45	28514.3	31182.4	17.72
Crane Neck	42 46 11.82	70 58 10.70	195 53 47 271 00 24	Powow Hill.....	15 55 17	11016.1	12046.9	6.84
				Old Town	91 05 30	10251.5	11210.7	6.37
Old Town	42 46 05.74	70 50 39.81	146 12 51 334 08 56	Powow Hill.....	326 09 15	12977.2	14191.5	8.06
				Tilton's Hill	154 11 16	10779.0	11787.6	6.70
Newburyport, (Harris street church.)	42 48 29.87	70 52 02.66	63 02 41 7 49 14	Crane Neck	242 58 31	9385.8	10264.0	5.83
				Prospect Rowley.....	187 48 27	11603.3	12689.0	7.21
Newburyport, (Upper Green church.)	42 47 56.71	70 51 25.09	343 16 02 70 41 30	Old Town.....	163 16 33	3575.6	3910.2	2.22
				Crane Neck	250 36 55	9769.8	10684.0	6.07

United States Coast Survey.—Geographical Positions. Section I.—Coast North of Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	
						Metres.	Yards.
Newburyport, (Pleasant street church.)	° ' " 42 48 36.60	° ' " 70 51 58.11	° ' " 339 04 18 62 13 09	Old Town Crane Neck	° ' " 159 05 11 242 08 56	4983.5 9573.1	5449.8 10468.9
Belleville Church.....	42 49 04.94	70 53 03.74	329 22 50 52 35 02	Old Town Crane Neck	149 24 28 232 31 34	6424.2 8785.4	7025.3 9607.5
Bartlett.....	42 50 02.63	70 55 02.70	30 58 18 160 12 30	Crane Neck Powow Hill.....	210 56 10 340 11 53	8304.5 3690.7	9081.6 4036.0
Byfield Church.....	42 44 17.17	70 55 32.76	134 34 54 243 16 36	Crane Neck Old Town	314 33 07 63 19 55	5040.8 7456.0	5512.5 8153.7
Rowley Church	42 42 57.17	70 52 21.29	127 06 53 201 37 41	Crane Neck Old Town	307 02 56 21 38 50	9960.3 6259.1	10892.3 6844.8
Town Farm, (tree on).....	42 43 02.06	70 50 30.99	69 21 50 177 58 31	Prospect Rowley..... Old Town	249 20 01 357 58 25	3916.3 5670.8	4282.8 6201.4
Ox Pasture.....	42 44 15.22	70 52 33.91	13 24 48 115 11 38	Prospect Rowley..... Crane Neck	193 24 22 295 07 49	3740.7 8460.4	4090.7 9252.0
Dummer Academy.....	42 45 14.42	70 53 38.50	353 42 54 167 52 00	Prospect Rowley..... Bartlett.....	173 43 12 347 51 03	5497.5 9095.7	6011.9 9946.8
Rowley Marsh.....	42 44 35.91	70 49 55.22	331 59 47 159 54 58	Tilton's Hill..... Old Town.....	152 01 37 339 54 28	7848.3 2951.3	8582.7 3227.5
Little Hill, Old Town.....	42 46 23.03	70 50 11.13	135 40 31 50 42 34	Bartlett..... Old Town.....	315 37 13 230 42 15	9475.7 842.3	10362.4 921.1
Plum Island East Light	42 48 25.10	70 48 40.24	109 08 36 91 51 00	Bartlett..... Harris Street Church.....	289 04 15 271 48 43	9193.5 4600.8	10053.7 5031.3

United States Coast Survey.—Geographical Positions. Section I.—Coast North of Cape Ann. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Plum Island West Light	42 48 25.08	70 48 45.82	109 24 30 91 54 43	Bartlett Harris Street Church	289 20 14 271 52 25	9074.1 4474.2	9873.2 4892.9	5.64 2.78
Plum Island (1)	42 46 35.20	70 47 56.60	42 03 55 122 20 54	Prospect Rowley Harris Street Church	222 00 26 302 18 07	10713.6 6616.9	11716.1 7236.0	6.66 4.11
Thompson's Hotel, Plum Island.	42 47 55.32	70 48 27.46	125 56 14 352 39 09	Powow Hill Tilton's Hill	305 51 07 172 39 59	12623.0 13191.5	13804.1 14425.8	7.84 8.20
Thompson's Flat	42 47 55.34	70 48 27.50	113 40 02 192 19 02	Bartlett Harris Street Church	293 35 33 282 16 36	9798.5 5003.1	10715.4 5471.2	6.09 3.11
Wood's Hotel, Plum Island . .	42 45 22.01	70 47 54.48	353 36 16 109 45 39	Tilton's Hill Old Town	173 36 44 289 43 47	8405.3 3993.4	9191.8 4367.1	5.22 2.48
Plum Island (2)	42 44 25.95	70 47 12.65	0 08 20 123 11 33	Tilton's Hill Old Town	180 08 19 303 09 12	6623.1 5627.3	7242.8 6153.8	4.12 3.50
East end of Barn, Plum Island.	42 43 00.18	70 46 30.38	13 49 21 135 17 25	Tilton's Hill Old Town	193 48 52 315 14 36	4095.2 8059.5	4478.4 8813.6	2.54 5.01
Salisbury Church	42 50 32.20	70 51 17.89	79 53 51 353 59 31	Bartlett Old Town	259 51 18 173 59 57	5184.8 8267.0	5670.0 9040.5	3.22 5.14
Seabrook	42 52 25.76	70 48 45.45	31 24 12 12 26 16	Harris Street Church Old Town	211 21 58 192 24 58	8598.1 12070.0	9402.6 13199.4	5.34 7.50
Hampton Falls	42 54 42.55	70 53 30.80	302 41 30 350 07 17	Seabrook Harris Street Church	122 44 45 170 08 17	7694.7 11671.6	8414.7 12773.9	4.78 7.25
Salisbury Beach	42 50 47.25	70 48 42.34	17 05 30 178 42 08	Old Town Seabrook	197 04 10 358 42 06	9086.6 3101.5	9936.8 3391.3	5.65 1.93

United States Coast Survey.—Geographical Positions. Section I.—Portsmouth Entrance. Sketch A.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Salisbury Marsh, (flag).....	42 51 05.04	70 49 50.56	210 04 19 289 30 48	Seabrook..... Salisbury Beach.....	30 05 03 109 31 34	2949.2 1643.1	3225.2 1796.8	1.83 1.02
Salisbury Powderhouse.....	42 51 20.27	70 54 30.30	192 11 46 27 45 57	Hampton Falls..... Crane Neck.....	12 12 27 207 43 27	6385.7 10753.4	6983.2 11759.6	3.97 6.68
West Salisbury Church.....	42 50 37.81	70 54 40.15	25 15 16 143 34 47	Bartlett..... Powow Hill.....	205 15 01 323 33 54	1200.1 2966.9	1312.4 3244.5	0.75 1.84
Batt's Hill.....	42 52 14.04	70 53 11.52	174 32 48 31 54 42	Hampton Falls..... Bartlett.....	354 32 37 211 53 26	4603.1 4775.7	5033.8 5223.6	2.86 2.97
Great Boar's Head.....	42 55 03.61	70 47 24.83	20 50 00 27 27 27	Seabrook..... Harris Street Church.....	200 49 05 207 24 18	5144.8 13687.4	5626.2 14968.1	3.20 8.50
PORTSMOUTH EN- TRANCE.								
Isles of Shoals, Hog Island..	42 59 13.06	70 36 29.07	12 52 59 166 19 49	Thompson's Hill..... Agamenticus.....	192 48 14 346 16 36	42819.2 26990.2	46825.8 29515.7	26.61 16.77
Pulpit Rock.....	43 01 56.74	70 42 47.14	185 48 24 300 30 14	Agamenticus..... Isles of Shoals.....	5 49 28 120 34 31	21281.3 9940.0	23272.6 10870.1	13.22 6.18
Newcastle.....	43 03 35.31	70 42 59.32	354 49 15 312 27 01	Pulpit Rock..... Isles of Shoals.....	174 49 23 132 31 27	3053.8 11981.0	3339.5 13102.1	1.90 7.44
White Island Light.....	42 58 00.40	70 37 44.63	199 45 39 168 55 06	Isles of Shoals..... Agamenticus.....	19 46 03 348 52 17	2382.4 29007.7	2605.3 31722.0	1.48 18.06

United States Coast Survey.—Geographical Positions. Section 1.—Saco River to Cape Elizabeth. Sketch A.

218

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
COAST FROM SACO RIVER TO CAPE ELIZABETH.								
MOUNT INDEPENDENCE	° ' " 43 45 32.17	° ' " 70 18 53.07	° ' " 60 54 21.3	Ossipee	° ' " 240 36 56.2	Metres. 38850.1	Yards. 42485.3	Miles. 24.14
Fletcher's Neck	43 26 50.90	70 20 11.94	116 00 38	Ossipee	206 40 27.6	66699.8	72895.9	41.44
Blue Point Hill	43 33 08.28	70 21 14.72	187 51 28	Mount Independence	295 44 10	35805.3	39155.6	22.25
Stratten Island	43 30 21.27	70 18 20.17	353 05 18	Fletcher's Neck	2 56 00	34646.2	37888.0	21.53
Grandy Hill	43 33 45.22	70 15 37.72	21 09 41	Blue Point Hill	7 53 06	23174.5	25342.9	14.40
Richmond Island	43 32 25.24	70 13 58.62	142 45 55	Fletcher's Neck	173 06 02	11730.9	12828.6	7.29
Bramhall's Hill	43 38 46.43	70 16 13.15	25 44 55	Stratten Island	201 08 25	6960.9	7612.2	4.32
Mount Joy	43 35 43.50	70 14 50.95	30 06 28	Grandy Hill	322 43 55	6474.7	7080.5	4.02
John's Hill	43 34 45.00	70 12 30.64	56 56 46	Mount Independence	205 41 47	14191.8	15519.7	8.82
Saco Church	43 30 01.29	70 26 13.81	137 59 13	John's Hill	210 04 36	7274.0	7954.6	4.52
				Stratten Island	236 53 46	7008.9	7664.7	4.35
				Grandy Hill	317 58 05	3322.5	3633.4	2.06
				Mount Independence	344 01 39	13022.8	14241.4	8.09
				John's Hill	146 12 48	8966.6	9805.6	5.57
				Richmond Island	196 01 57	3797.5	4152.8	2.36
				Mount Independence	169 08 25	6229.6	6812.5	3.87
				Blue Point Hill	336 44 49	21730.8	23764.1	13.50
				Fletcher's Neck	255 42 29	12133.1	13268.4	7.54
				Blue Point Hill	125 52 48	10032.8	10971.6	6.23
					49 21 31	8854.1	9682.6	5.50

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.		Longitude.		Azimuth.	To station—	Back azimuth.		Distance.	Distance.	Distance.
	°	' "	°	' "			°	' "	Metres.	Yards.	Miles.
Blue Point Hill, (tree).....	43	33 06.56	70	21 19.16	352 34 18 321 44 49	Fletcher's Neck..... Stratten Island.....	172 35 04 141 46 53	11690.4 6493.6	12784.3 7101.2	6.26 4.04	
Staples' Boarding-house.....	43	31 02.85	70	22 21.31	201 06 38 339 29 11	Blue Point Hill..... Fletcher's Neck.....	21 07 24 159 30 40	4149.5 8300.5	4537.8 9077.2	2.58 5.16	
Ram Island, (tall tree).....	43	28 00.23	70	21 04.95	330 52 31 178 40 42	Fletcher's Neck..... Blue Point Hill.....	150 53 08 358 40 35	2448.9 9508.8	2678.0 10398.5	1.52 5.91	
Stage Island Monument.....	43	27 22.82	70	20 45.82	210 42 41 176 31 06	Stratten Island..... Blue Point Hill.....	30 44 21 356 30 46	6405.9 10680.1	7005.3 11679.4	3.98 6.64	
Beacon on pier, mouth of Saco river.	43	27 42.27	70	21 53.18	224 16 10 184 54 14	Stratten Island..... Blue Point Hill.....	44 18 36 4 54 41	6854.3 10097.2	7495.7 11042.0	4.26 6.27	
Biddeford, (tall spire).....	43	29 30.13	70	27 11.41	229 55 07 297 29 22	Blue Point Hill..... Fletcher's Neck.....	49 59 13 117 34 11	10462.8 10631.2	11441.8 11626.0	6.50 6.61	
Hubbard's Point, (house)...	43	33 19.04	70	17 21.19	17 46 23 13 34 29	Fletcher's Neck..... Stratten Island.....	197 44 26 193 33 48	12576.4 5643.1	13753.2 6171.1	7.81 3.51	
Pool, (cupola of old ware- house.)	43	26 47.28	70	20 59.02	208 22 47 178 17 04	Stratten Island..... Blue Point Hill.....	28 24 36 358 16 53	7506.5 11762.5	8208.9 12863.1	4.66 7.31	
Prout's Neck, (Libby's house).	43	31 53.64	70	18 53.23	125 57 53 345 23 44	Blue Point Hill..... Stratten Island.....	305 56 15 165 24 07	3923.3 2945.0	4290.4 3220.6	2.44 1.83	
Wood Island Light.....	43	27 23.01	70	19 24.95	166 58 51 218 08 11	Blue Point Hill..... Richmond Island.....	346 57 35 38 11 56	10936.4 11862.5	11959.7 12972.5	6.79 7.37	
Richmond Island, (barn on)...	43	32 36.73	70	13 54.98	12 58 05 95 40 33	Richmond Island..... Blue Point Hill.....	192 58 02 275 35 30	364.0 9918.2	398.1 10846.3	0.23 6.16	

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Richmond Island, (Dr. Cummings' chimney.)	43 32 37.91	70 14 02.79	95 33 50 346 32 16	Blue Point Hill..... Richmond Island.....	275 28 52 166 32 19	9740.5 402.1	10651.9 439.7	6.05 0.25
Cape Elizabeth West Light..	43 33 49.81	70 11 49.43	48 01 26 88 26 08	Richmond Island..... Grandy Hill.....	227 59 57 268 23 31	3990.7 5125.0	4265.7 5604.6	2.42 3.18
Cape Elizabeth East Light...	43 33 56.30	70 11 40.86	47 44 46 86 20 27	Richmond Island..... Grandy Hill.....	227 43 11 266 17 43	4177.5 5326.4	4568.4 5824.8	2.59 3.31
Jordan's Barn, (pole on east end.)	43 33 21.85	70 14 10.21	45 13 42 87 31 32	Stratten Island..... Blue Point Hill.....	225 10 49 267 26 39	7908.5 9536.6	8648.5 10428.9	4.91 5.93
Yellow House, (west base of Grandy hill.)	43 33 24.91	70 15 40.76	32 17 20 186 13 04	Stratten Island..... Grandy Hill.....	212 15 33 6 13 06	6702.3 630.5	7329.4 689.5	4.16 0.39
Mount Misery	43 35 45.75	70 13 20.94	7 47 07 65 28 49	Richmond Island..... Blue Point Hill.....	187 46 43 245 23 22	6245.1 11687.5	6829.5 12781.1	3.88 7.26
Munjoy Observatory.....	43 39 54.04	70 14 34.31	347 42 45 35 40 51	Mount Misery..... Blue Point Hill.....	167 53 36 215 36 15	7837.1 15407.8	8570.4 16849.5	4.87 9.57
Scottaway Hill, (Waterhouse's house.)	43 35 13.84	70 21 51.01	288 02 38 229 04 28	Grandy Hill..... Bramhall's Hill.....	108 06 55 49 08 21	8810.1 10020.6	9634.5 10958.2	5.47 6.23
Bennett's House, (Brown's Hill.)	43 38 02.03	70 17 02.33	218 48 26 32 00 26	Bramhall's Hill..... Blue Point Hill.....	38 49 00 211 57 32	1758.5 10687.2	1923.1 11687.2	1.09 6.64
Spurwink Church	43 34 45.47	70 14 46.80	177 01 30 225 59 15	Mount Joy..... Mount Misery.....	357 01 27 46 00 14	1792.7 2677.5	1960.4 2928.0	1.11 1.66
Sand Knoll, (opposite Richmond island.)	43 33 12.09	70 15 00.56	316 06 39 140 47 43	Richmond Island..... Grandy Hill.....	136 07 22 320 47 17	2006.1 1319.7	2193.8 1443.1	1.25 0.82

United States Coast Survey.—Geographical Positions. Section I.—Saco River to Cape Elizabeth. Sketch A.

Name of station.	Latitude.	Longitude.	Azinuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
High Head Point, (signal) . . .	43 33 30.30	70 11 58.75	53 17 05 95 22 37	Richmond Island..... Grandy Hill	233 15 42 275 20 06	3357.0 4935.5	3671.1 5397.3	2.08 3.07
Ram Island, (signal mouth of Spurwink river.)	43 32 58.77	70 15 16.43	300 37 56 161 34 20	Richmond Island..... Grandy Hill	120 38 50 341 34 06	2029.9 1511.2	2219.8 1652.6	1.26 0.94

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
FIRE ISLAND BASE, } East end (Long Island,) } West end	40 40 00.83	73 02 59.60	252 53 36.6	.....	.....	.....	.....	.....
	40 37 47.14	73 12 31.74	.....	East Base.....	72 59 49.3	14059.0	15374.5	8.74
Ruland's Hill.....	40 50 39.21	73 01 37.99	5 33 35.0	.....	185 32 41.7	19783.1	21634.2	12.29
			32 50 37.1	West Base.....	212 43 30.5	28325.3	30975.7	17.60
West Hills.....	40 48 52.60	73 25 12.25	297 33 43.4	.....	117 48 13.1	35304.5	38607.9	21.94
			318 55 29.2	East Base.....	139 03 45.3	27198.5	29743.7	16.90
			264 12 12.9	West Base.....	84 27 37.5	33296.5	36412.0	20.69
Tashua Hill.....	41 15 35.41	73 14 41.16	338 18 46.5	.....	158 27 20.9	49641.6	54286.5	30.85
			16 39 30.0	Ruland's Hill.....	196 32 35.6	51589.4	56416.6	32.06
Bald Hill.....	41 12 47.39	73 28 21.61	254 44 45.3	.....	74 53 46.1	19794.4	21646.6	12.30
			354 16 26.4	Tashua Hill.....	174 18 30.7	44476.9	48638.6	27.64
			317 24 59.0	West Hills.....	137 42 31.7	55510.4	60704.5	34.49
Harrow.....	40 47 52.89	73 38 02.17	196 20 42.2	.....	16 27 03.1	48052.4	52548.7	29.86
			264 06 10.0	Bald Hill.....	84 14 33.1	18138.1	19835.3	11.27
Round Hill.....	41 06 10.65	73 40 05.79	233 13 55.9	.....	53 21 39.4	20475.6	22391.5	12.72
			355 06 31.4	Bald Hill.....	175 07 52.4	33983.3	37163.1	21.12
			326 47 32.4	Harrow.....	146 57 18.1	38232.5	41809.9	23.75
Buttermilk Hill.....	41 06 33.91	73 48 18.96	273 31 20.4	.....	93 36 44.6	11528.4	12607.1	7.16
			337 18 04.2	Round Hill.....	157 24 48.4	37465.1	40969.7	23.28
Weasel.....	40 52 34.18	74 10 52.41	230 33 51.2	.....	50 48 39.0	40882.9	44708.4	25.40
			280 28 01.6	Buttermilk Hill.....	100 49 30.0	46962.6	51356.9	29.18
Beacon Hill.....	40 22 23.74	74 13 22.06	183 35 24.7	.....	3 37 02.1	55949.8	61184.7	34.76
			226 23 36.6	Weasel.....	46 46 35.7	68622.4	75043.4	42.64

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Springfield	40 41 19.44	74 21 05.44	258 26 30.9 342 39 56.7	Harrow	78 54 36.9	61803.0	67585.9	38.40
				Beacon Hill	162 44 57.8	36685.8	40118.5	22.80
Disboro'	40 14 45.43	74 27 06.10	189 46 18.1 233 55 39.3	Springfield	9 50 12.2	49891.0	54559.3	31.00
				Beacon Hill	54 04 32.3	24048.4	26298.6	14.94
Mount Rose	40 22 00.56	74 43 06.14	220 53 27.8 300 32 22.8 268 51 57.9	Springfield	41 07 46.1	47366.7	51798.8	29.43
				Disboro'	120 42 43.8	26342.5	28807.4	16.37
				Beacon Hill	89 11 13.5	42091.3	46029.8	26.15
Stony Hill.....	40 07 09.59	75 34 33.06	156 14 04.5 216 54 16.5	Mount Rose.....	336 08 33.1	30034.9	32845.3	18.66
				Disboro'	36 59 04.9	17590.5	19236.5	10.93
Newtown.....	40 15 00.50	74 54 54.37	232 10 12.8 296 34 50.2	Mount Rose.....	52 17 50.9	21153.1	23132.4	13.14
				Stony Hill.....	116 47 58.2	32333.9	35359.4	20.09
Mount Holly	40 00 06.12	74 46 59.70	187 44 22.8 233 30 05.5 157 52 33.6	Mount Rose.....	7 46 53.5	40912.6	44740.8	25.42
				Stony Hill.....	53 38 06.0	21990.8	23998.5	13.66
				Newtown.....	337 47 27.7	29784.1	32571.0	18.51
Willow Grove	40 08 28.97	75 06 02.79	299 41 34.4 232 33 57.4	Mount Holly.....	119 53 50.2	31209.1	34128.7	19.39
				Newtown.....	52 41 08.8	19892.3	21753.6	12.36
Pine Hill.....	39 47 51.03	74 59 16.50	217 36 08.5 165 51 49.9	Mount Holly.....	37 44 01.1	28639.0	31318.7	17.80
				Willow Grove.....	345 47 28.9	39375.9	43060.3	24.47
Yard	39 58 21.75	75 22 54.41	266 12 16.0 299 52 35.0	Mount Holly.....	86 35 20.6	51215.8	56008.1	31.82
				Pine Hill.....	120 07 44.2	38898.4	42538.1	24.17
Bethel	39 50 43.14	75 29 05.98	276 57 01.7 211 55 43.7	Pine Hill.....	97 16 07.7	42882.8	46895.3	26.65
				Yard	31 59 42.1	16670.5	18230.4	10.36

United States Coast Survey.—Geographical Positions. Section II.—Primary Stations. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lippencott	39 43 17.44	75 18 30.36	132 19 20.0 167 20 21.4 252 49 10.9	Bethel	312 12 33.3 347 17 32.2 73 01 29.0	20435.9 28585.5 28729.6	22348.1 31260.3 31417.8	12.70 17.76 17.85
Burden	39 31 45.74	75 22 33.40	165 06 10.7 195 10 47.2	Bethel	345 02 00.0 15 13 22.2	36300.7 22103.8	39697.4 24172.1	22.55 13.74
Meetinghouse Hill	39 42 43.12	75 42 20.85	268 05 37.3 305 29 29.8	Lippencott	88 20 51.3 125 42 07.0	34084.4 34826.9	37273.7 38085.6	21.18 21.64
Buck	39 32 23.56	75 43 35.89	272 06 14.9 185 20 39.4	Burden	92 19 38.6 5 21 27.2	30168.4 19189.3	32991.3 20984.9	18.74 11.92
Principio	39 35 33.46	75 59 57.25	242 09 19.4 283 57 01.2	Meetinghouse Hill	62 20 33.5 104 07 26.3	28455.2 24143.4	31117.8 26402.5	17.68 15.00
Deakyne	39 22 49.69	75 31 23.39	217 25 20.0 135 22 08.3	Burden	37 30 56.8 315 14 22.7	20826.9 24894.5	22775.7 27023.9	12.94 15.47
Pine Mount	39 25 00.57	75 19 56.46	163 18 14.0 76 15 48.5	Burden	343 16 34.2 256 08 32.5	13044.9 16922.9	14265.5 18506.4	8.11 10.51
Deep Water	39 11 51.33	75 22 52.73	148 57 55.7 189 49 39.9	Deakyne	328 52 32.3 9 51 31.5	23703.8 24700.7	25921.8 27011.9	14.73 15.34
Joscelyne	39 18 37.02	75 08 03.49	124 47 10.0 59 40 26.6	Pine Mount	304 39 37.8 239 31 03.9	20763.9 24717.9	22706.8 27030.7	12.90 15.36
				Deep Water				

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
LONG ISLAND SOUND.								
Principal Series.								
Friar's Head	40 58 13.42	72 43 20.97	61 28 37.2 126 24 19.4	Ruland's Hill	241 16 38.8	29245.5	31982.0	18.17
Mount Carmel	41 25 49.46	72 53 05.34	57 57 23.6 10 27 14.7	Tashua Hill	237 43 07.6	35582.2	38911.6	22.11
				Ruland's Hill	190 21 37.4	66179.6	72372.0	41.12
Sugarloaf	41 22 39.51	72 43 34.61	73 46 26.3 359 35 35.6	Tashua Hill	253 25 54.0	45248.7	49482.6	28.12
				Friar's Head	179 35 44.6	44915.5	49118.2	27.91
Williams	41 21 16.62	72 30 49.11	22 24 03.1 97 16 28.2	Friar's Head	202 15 48.2	46125.3	50441.2	28.66
				Sugarloaf	277 08 02.3	17931.1	19608.9	11.14
Shelter Island	41 04 36.59	72 21 19.22	69 10 29.1 156 46 08.9	Friar's Head	248 56 01.6	33061.0	36154.5	20.54
				Williams	336 39 53.4	33581.8	36724.1	20.87
Nickerson	41 23 51.55	72 19 19.01	4 30 11.6 73 27 59.2	Shelter Island	184 28 52.4	35736.1	39079.9	22.21
				Williams	253 20 23.1	16731.5	18295.5	10.40
Montauk	41 03 52.01	71 53 57.65	136 23 03.1 92 12 17.6	Nickerson	316 06 20.4	51226.6	56019.9	31.83
				Shelter Island	271 54 19.1	38344.2	41932.1	23.83
Lantern Hill	41 27 35.67	71 56 20.11	355 40 09.3 77 56 24.5	Montauk	175 41 43.3	44039.9	48160.7	27.36
				Nickerson	257 41 12.1	32751.1	35815.9	20.35
Beacon Hill (Block Island) ..	41 10 29.75	71 35 49.74	65 06 09.5 137 05 04.2	Montauk	244 53 47.7	29029.6	31745.9	18.04
				Lantern Hill	316 51 05.4	43293.0	47343.9	26.90
Champlin	41 29 13.76	71 46 26.97	77 39 13.1 335 30 45.9	Lantern Hill	257 32 40.3	14089.7	15408.1	8.75
				Beacon Hill	155 38 13.1	38079.9	41643.0	23.66

United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
McSparran Hill.....	41 29 44.72	71 27 03.80	88 04 46.8 17 38 21.4	Champlin..... Beacon Hill.....	267 51 56.2 197 33 00.5	26995.2 37375.3	29521.1 40872.5	16.77 23.22
East Rock.....	41 27 02.41	71 11 17.31	102 55 53.0 47 32 41.0	McSparran Hill..... Beacon Hill.....	282 45 26.1 227 16 55.4	22522.1 45249.0	24629.5 49482.9	13.99 28.12
RHODE ISLAND AND CONNECTICUT.								
<i>Point Judith to Stonington.</i>								
Tiff's Hill.....	41 27 46.33	71 31 54.79	8 05 16 97 40 19	Beacon Hill..... Champlin.....	188 03 07 277 30 42	32296.0 20413.7	35317.9 22323.8	20.07 12.69
Broadhill.....	41 24 37.69	71 33 21.94	115 07 25 222 46 57	Champlin..... McSparran Hill.....	294 58 45 42 51 07	20111.8 12912.0	21993.7 14120.2	12.50 8.02
Watch Hill.....	41 18 47.64	71 50 56.44	8 42 23 304 46 55	Montauk..... Beacon Hill.....	188 40 24 124 57 19	27948.7 26865.1	30564.4 29378.9	17.37 16.69
Austin.....	41 24 23.02	71 28 23.96	93 46 08 190 36 36	Broad Hill..... McSparran Hill.....	273 42 51 10 37 29	6935.1 10096.7	7584.0 11041.5	4.31 6.27
Point Judith.....	41 21 52.55	71 28 57.00	189 23 16 129 38 20	Austin..... Broad Hill.....	9 23 38 309 35 24	4704.8 7989.6	5145.0 8737.2	2.92 4.96
Point Judith Light.....	41 21 37.63	71 28 33.74	24 08 18 80 35 19	Beacon Hill..... Watch Hill.....	204 03 57 260 20 32	22570.2 31654.8	24682.1 34616.7	14.03 19.67
Weeden.....	41 22 48.62	71 32 54.34	169 13 00 245 05 59	Broad Hill..... Austin.....	349 12 42 65 08 58	3425.3 6923.1	3745.8 7570.9	2.13 4.30

United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	
							Metres.	Yards.
Kingston Spire.....	41 28 46.66	71 31 12.66	92 20 30	Champlin.....	272 10 24	21226.3	23212.4	13.19
Meeting-house Hill.....	41 26 43.09	71 28 12.99	17 55 50	Beacon Hill.....	197 51 15	21550.9	34500.1	19.60
Boston Neck.....	41 28 16.86	71 25 44.49	50 00 16	Meeting-house Hill.....	229 58 38	4499.4	4920.4	2.80
Tower Hill Spire.....	41 28 00.62	71 27 14.28	18 52 41	Beacon Hill.....	198 47 27	34250.9	37455.7	21.28
Newport Spire.....	41 29 12.23	71 18 28.71	34 00 06	Tiff's Hill.....	266 05 59	6523.7	7134.1	4.05
Sherman.....	41 30 14.74	71 30 35.10	21 59 50	Beacon Hill.....	213 49 05	41721.9	45596.0	25.92
Wakefield, (flag-staff).....	41 26 02.78	71 30 19.14	85 13 05	Tiff's Hill.....	261 51 42	18888.1	20655.5	11.74
Shannock.....	41 28 03.00	71 38 00.69	213 29 18	Champlin.....	201 58 57	4937.4	5399.4	3.07
Wilbur.....	41 29 27.39	71 38 11.63	246 59 08	McSparran Hill.....	265 02 34	22156.7	24229.9	13.77
Wilcox.....	41 21 20.87	71 38 00.69	314 21 27	Meeting-house Hill.....	33 31 27	8211.2	8979.5	5.10
James.....	41 32 39.59	71 39 32.08	280 11 32	Broad Hill.....	67 00 32	3181.2	3478.9	1.98
			87 57 02	Meeting-house Hill.....	134 24 32	9054.5	9901.7	5.63
			323 00 46	Champlin.....	100 18 01	13860.0	15156.9	8.61
			329 24 30	Broad Hill.....	267 51 34	11496.2	12571.9	7.14
			65 06 17	Beacon Hill.....	143 03 58	11184.1	12230.6	6.95
			15 19 53	Watch Hill.....	149 30 06	23323.3	25505.7	14.49
			56 36 36	Wilcox.....	245 01 28	11215.1	12264.5	6.96
				Champlin.....	195 17 09	21707.5	23738.7	13.49
					236 32 01	11526.0	12604.5	7.16

United States Coast Survey.—Geographical Positions. Section II.—Rhode Island and Connecticut. Sketch B, No. 2.

228

S. Doc. 3.

Name of station.	Latitude, ° ' "	Longitude, ° ' "	Azimuth, ° "	To station—	Back azimuth, ° ' "	Distance, Metres.	Distance, Yards.	Distance, Miles.
Green Hill	41 22 22.41	71 35 30.68	358 43 41 80 33 12	Beacon Hill	178 43 55	21900.2	23949.4	13.61
				Wilcox	260 27 50	11506.5	12583.2	7 15
Joshua Champlin	41 22 14.12	71 39 34.47	344 08 44 267 23 10	Beacon Hill	164 11 39	22585.0	24698.3	14.03
				Green Hill	87 25 51	5670.7	6201.3	3.52
Noyes' Point	41 19 44.02	71 44 58.60	321 13 36 211 45 15	Beacon Hill	141 20 05	21916.0	23966.1	13.62
				Wilcox	31 46 07	3514.6	3842.9	2.18
Quanacontog	41 19 57.68	71 42 16.47	83 37 44 143 13 53	Noyes' Point	263 35 57	3793.5	4148.5	2.36
				Wilcox	323 12 58	3204.9	3504.8	1 99
Sand Hill.	41 21 38.30	71 41 56.53	77 17 45 8 29 51	Wilcox	257 16 37	2441.9	2670.4	1.52
				Quanacontog	188 29 38	3139.0	3432.7	1.95
Block Island Light-house....	41 13 26.84	71 34 12.19	57 25 49 113 02 24	Montauk	237 12 49	32841.3	35914.3	20.41
				Watch Hill	292 51 21	25381.0	27755.9	15.77
Bushy Hill	41 12 41.67	71 33 19.66	32 14 09 114 45 01	Beacon Hill	212 12 56	4810.4	5260.0	2.99
				Watch Hill	294 33 24	27065.0	29597.5	16.82
Eell's Hill, (2)	41 22 47.59	71 50 43.61	2 18 12 138 42 27	Watch Hill	182 18 03	7408.2	8101.4	4.60
				Lantern Hill	318 38 44	11833.8	12941.1	7.35
Peleg Tiff	41 23 16.45	71 48 19.64	23 44 17 298 38 29	Watch Hill	203 42 33	9058.6	9906.2	5.63
				Wilcox	118 41 34	7431.0	8126.4	4.62
Cranberry Hill	41 20 50.91	71 47 01.97	258 53 32 158 06 26	Wilcox	78 55 46	4806.8	5256.6	2.99
				Peleg Tiff	938 05 35	4838.4	5291.1	3.91
Cormorant Hill	41 23 34.93	71 48 42.67	62 32 51 316 48 29	Eell's Hill, (2)	242 31 29	3166.7	3463.0	1.97
				Peleg Tiff	136 48 46	781.9	855.1	0.49

United States Coast Survey.—Geographical Positions. Section 11.—Rhode Island and Connecticut. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Big Hill.....	41 23 34.06	71 45 47.69	20 04 41 86 12 22	Cranberry Hill..... Peleg Tiff.....	200 03 52 266 10 42	5029.5 3537.4	5500.1 3868.4	3.13 2.20
Wells' Hill.....	41 25 54.36	71 44 55.13	14 45 18 44 17 32	Big Hill..... Peleg Tiff.....	194 44 43 224 15 17	4794.2 6803.0	5242.8 7469.6	2.93 4.33
Diamond Hill, (tree).....	41 25 44.26	71 46 07.92	353 47 52 33 52 06	Big Hill..... Peleg Tiff.....	173 48 05 213 50 39	4349.9 5490.3	4756.9 6004.0	2.70 3.41
Quacatog	41 23 13.01	71 56 37.87	182 54 32 275 24 41	Lantern Hill..... Eell's Hill, (2).....	2 54 44 95 28 36	8113.2 8267.8	8872.4 9041.4	5.04 5.14
Grant's Hill	41 25 22.90	71 53 45.35	138 46 02 45 00 17	Lantern Hill..... Quacatog	318 44 20 224 58 23	5447.2 5665.7	5956.9 6195.8	3.39 3.52
North Stonington.....	41 25 57.30	71 50 59 92	356 17 49 323 06 18	Eell's Hill, (2)..... Peleg Tiff.....	176 17 57 143 08 06	5864.3 6202.8	6413.0 6783.2	3.64 3.85
Jesse Main.....	41 26 29.36	71 48 54.25	73 09 03 20 22 42	Grant's Hill	253 05 50	7062.2	7723.0	4.39
Chapman's Hill.....	41 29 29.95	71 51 19.83	63 11 10 23 54 53	Eell's Hill, (2)..... Lantern Hill..... Grant's Hill	200 21 30 243 07 51 203 53 17	7297.8 7806.9 8335.5	7980.7 8537.4 9115.5	4.53 4.85 5.18
Road Meeting-house.....	41 22 21.14	71 54 30.49	322 54 30 261 10 45	Watch Hill..... Eell's Hill, (2).....	142 56 51 81 13 15	8255.0 5334.2	9027.4 5833.3	5.13 3.32
Mount Prospect, (Fisher's Island.)	41 15 19.18	72 00 15.22	193 30 07 337 24 55	Lantern Hill..... Montauk	13 32 43 157 29 03	23366.5 22951.0	25552.9 25098.5	14.52 14.26
Watch Hill Light	41 18 11.42	71 51 11.49	197 23 45 67 16 10	Watch Hill..... Mount Prospect.....	17 23 55 247 10 48	1171.0 13723.0	1280.6 15007.1	0.73 8.53

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		Q ' "	Metres.	Yards.	Miles.
Fort Hill.....	41 20 45.42	72 00 20.00	285 26 42 359 21 59	Watch Hill..... Mount Prospect.....	105 32 54 179 22 02	13598.1 10062.7	14870.5 11044.3	8.45 6.25
Chocomount.....	41 16 45.75	71 57 27.32	151 29 48 247 30 05	Fort Hill..... Watch Hill.....	331 27 54 67 34 23	8413.3 9838.9	9200.5 10759.5	5.23 6.11
East End	41 17 03.95	71 55 43.20	62 59 13 136 43 31	Mount Prospect..... Fort Hill.....	242 56 14 316 40 29	7108.0 9387.0	7773.1 10265.3	4.42 5.83
Wampasset Point	41 19 42.36	71 54 56.18	104 30 54 32 50 59	Fort Hill..... Chocomount	284 27 20 212 49 05	7776.0 6484.0	8503.6 7090.7	4.83 4.22
Wicopisset	41 17 37.84	71 54 31.49	246 41 33 171 29 52	Watch Hill..... Wampasset Point	66 43 55 351 29 36	5446.1 3884.0	5955.7 4247.4	3.39 2.41
Stonington,* (new light-house)	41 19 38.73	71 54 00.17	0 00	Stonington Old Light	180 00	61.7	67.5	0.04
Stonington, (old light-house).	41 19 36.73	71 54 00.17	289 30 06 42 25 44	Watch Hill..... Chocomount	109 32 07 222 23 27	4534.0 7160.0	4958.3 7829.9	2.82 4.45
Mystic Light-house	41 18 57.08	71 59 02.51	53 20 02 331 19 26	Groton Long Point	233 19 24 151 20 29	1684.0 4617.0	1841.6 5049.0	1.05 2.87
LONG ISLAND SOUND.								
Thames River.								
Avery's Point.....	41 18 55.29	72 03 31.90	325 30 39 232 42 02	Mount Prospect..... Fort Hill.....	145 32 49 52 44 09	8086.0 5608.0	8843.6 6162.7	5.03 3.49
Groton Long Point	41 18 24.49	72 00 00.58	3 24 44 100 57 26	Mount Prospect..... Avery's Point.....	183 24 34 280 55 07	5726.0 5006.0	6261.8 5474.4	3.56 3.11

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
North Hammock.....	41 17 14.37	72 00 50.58	346 57 00 280 33 40	Mount Prospect..... Chocomount.....	166 57 23 100 35 54	3647.0 4811.0	3982.2 5261.2	2.27 2.99
North Hill	41 16 21.04	72 01 05.91	328 15 21 261 27 41	Mount Prospect..... Chocomount.....	148 15 54 81 30 05	2243.3 5143.0	2455.2 5624.2	1.40 3.20
Race Point.....	41 15 01.41	73 01 57.74	257 03 04 206 08 56	Mount Prospect..... North Hill.....	77 04 12 26 09 30	2449.0 2737.0	2678.2 2993.1	1.52 1.69
Goshen Point.....	41 17 55.33	72 06 27.27	299 03 18 238 24 21	Mount Prospect..... Fort Hill.....	119 07 23 58 28 23	9907.2 10022.9	10834.2 10960.7	6.16 6.23
Race Rock Spindle.....	41 14 34.46	72 02 30.35	138 21 26 246 18 27	Goshen Point..... Mount Prospect.....	318 18 50 66 19 56	8295.0 3435.0	9071.2 3756.4	5.15 2.14
New London Light-house....	41 18 57.66	72 05 04.07	315 03 43 10 30 17	Mount Prospect..... Gull Island.....	135 06 54 190 29 10	9519.0 12975.8	10409.7 14190.0	5.92 8.06
Vinegar Hill.....	41 25 25.09	72 03 00.87	348 20 33 246 32 58	Mount Prospect..... Lantern Hill.....	168 22 22 66 37 23	19083.0 10136.9	20863.6 11085.4	11.86 6.30
Browning	41 25 03.28	72 06 02.98	335 48 01 250 47 15	Mount Prospect..... Lantern Hill.....	155 51 51 70 53 41	19748.6 14323.6	21596.5 15663.9	12.27 8.90
Quaker	41 22 44.07	72 06 05.40	329 16 53 220 46 26	Mount Prospect..... Vinegar Hill.....	149 20 44 40 48 28	15957.8 6560.8	17451.0 7174.7	9.92 4.08
Manetuck.....	41 21 13.26	72 08 42.54	312 44 24 232 29 22	Mount Prospect..... Quaker.....	132 49 59 52 31 06	16078.9 4601.9	17583.4 5032.5	9.99 2.86
New London, (Presbyterian church spire.)	41 21 16.31	72 05 29.38	88 48 59 162 48 48	Manetuck..... Quaker.....	268 46 51 342 48 24	4490.4 2833.7	4910.6 3098.9	2.79 1.76

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Fort Trumbull, (flag-staff.)...	41 20 35.98	72 05 18.50	103 38 51 164 34 39	Manetuck..... Quaker.....	283 36 36 344 34 08	4880.1 4098.8	5336.7 4482.3	3.03 2.55
Groton Monument.....	41 21 15.72	72 04 26.81	89 17 29 139 57 12	Manetuck..... Quaker.....	269 14 40 319 56 07	5944.1 3560.5	6500.4 3893.7	3.69 2.21
Tory Hill.....	41 31 02.19	72 03 44.67	354 24 48 301 40 05	Vinegar Hill..... Lantern Hill.....	174 25 17 121 44 59	10448.4 12121.0	11426.1 13225.2	6.49 7.53
Pole's Hill.....	41 27 12.25	72 07 20.94	298 40 45 215 14 57	Vinegar Hill..... Tory Hill.....	118 43 37 35 17 20	6882.8 8687.9	7526.8 9500.8	4.28 5.40
Mohican Spire	41 28 21.60	72 05 34.65	3 55 33 326 44 22	Quaker	183 55 13 146 46 04	10436.5 6510.4	11413.1 7119.6	6.49 4.05
Gull Island	41 12 04.07	72 06 45.57	236 27 27 170 53 05	Mount Prospect..... Manetuck.....	56 31 44 350 51 48	1090.2 1715.8	1192.2 1876.4	0.68 1.07
<i>Long Island Sound.</i>								
Sachem's Head.....	41 16 56.20	72 43 10.40	244 56 49 176 52 04	Williams..... Sugarloaf.....	65 04 59 356 51 48	19018.8 10297.3	20798.4 11260.8	11.82 6.40
Hammonasset,.....	41 14 53.58	72 32 19.95	190 07 53 131 55 53	Williams..... Sugarloaf.....	10 08 53 311 48 27	12002.7 21071.5	13125.8 23045.3	7.46 13.09
Mattituck Hills.....	41 00 06.03	72 34 09.20	74 58 44 158 00 04	Friar's Head..... Sachem's Head.....	354 52 42 337 54 08	13355.0 33618.9	14604.6 36764.6	8.30 20.89
Horton's Point.....	41 04 55.80	72 26 33.07	50 02 33 156 21 13	Mattituck Hills..... Hammonasset,.....	229 57 33 336 17 25	13906.6 20133.9	15207.8 22017.8	8.65 12.51

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Cornfield Point.....	41 15 39.86	72 22 53.76	83 52 12 14 26 57	Hammonasset..... Horton's Point.....	263 46 00 194 24 33	13258.0 20515.1	14498.6 22434.7	8.24 12.75
Brown's Hill.....	41 09 08.91	72 17 15.87	59 03 30 116 51 56	Horton's Point..... Hammonasset.....	238 57 23 296 42 00	15163.6 23593.6	16582.5 25801.3	11.42 14.66
Hatchett's Point.....	41 16 56.48	72 15 22.96	77 20.46 10 20 39	Cornfield Point..... Brown's Hill.....	257 15 48 190 19 25	10754.8 14661.4	11661.4 16033.5	6.68 9.11
Gardiner's Island.....	41 06 03.21	72 06 01.64	205 10 39 283 24 12	Mount Prospect..... Montauk	25 14 26 103 32 08	18954.5 17374.7	20728.1 19000.9	7.31 10.80
Black Point.....	41 17 07.36	72 11 59.12	337 50 34 26 35 19	Gardiner's Island..... Brown's Hill.....	157 54 29 206 31 50	22116.5 16500.6	24185.9 18044.6	13.74 10.26
Two-tree Island.....	41 17 38.49	72 08 51.34	181 46 21 77 37 24	Manetuck	1 46 27	6628.0	7248.2	4.12
Millstone Point	41 18 16.60	72 09 33.79	57 44 05 341 10 07	Black Point..... Gull Island.	237 42 29 161 11 44	3999.0 12140.4	4373.2 13276.4	2.49 7.54
Plum Island	41 11 03.51	72 10 33.65	69 22 35 325 34 32	Brown's Hill..... Gardiner's Island.....	249 18 11 145 37 31	10019.5 11226.1	10957.0 12336.5	6.23 6.97
Gull Island Light-house.....	41 12 20.65	72 06 05.12	359 36 18 69 12 37	Gardiner's Island. Plum Island	179 36 20 249 09 43	11642.6 6694.6	12733.0 7321.0	7.23 4.15
Great Gull Island, (2).....	41 12 04.04	72 06 45.84	354 42 27 70 38 26	Gardiner's Island..... Plum Island.....	174 42 57 250 35 56	11178.4 5627.1	12224.4 6153.6	6.95 3.50
Four-mile River.....	41 18 09.85	72 15 52.82	311 28 48 283 28 51	Gull Island	131 34 50	17017.4	18609.7	6.66
				Mount Prospect.....	103 39 10	22443.1	24543.1	13.95

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Plum Island Light-house.....	41 10 23.29	72 12 22.31	71 39 36 161 22 46	Brown's Hill..... Four-mile River.....	251 26 23 341 10 38	7217.0 15203.0	7892.3 16625.5	4.48 9.45
<i>Connecticut River.</i>								
Malicah.....	41 20 32.83	72 19 48.68	186 24 51 95 05 19	Nickerson..... Williams.....	6 25 11 274 58 03	6168.3 15410.9	6745.5 16852.9	3.83 9.58
Essex.....	41 20 31.02	72 23 28.57	223 07 52 269 21 15	Nickerson..... Malicah.....	43 10 37 89 23 41	8478.9 5112.3	9272.3 5590.7	5.27 3.18
Pettipang Spire.....	41 21 03.60	72 24 32.87	234 35 01 278 09 08	Nickerson..... Malicah.....	54 38 29 98 12 16	8945.4 6674.0	9782.4 7298.5	5.56 4.15
Ely.....	41 21 49.15	72 22 06.68	306 16 00 38 18 28	Malicah..... Essex.....	126 17 31 218 17 34	3979.0 3071.3	4351.3 3358.7	2.47 1.91
Essex Spire.....	41 21 09.38	72 23 15.45	283 10 51 14 27 59	Malicah..... Essex.....	103 13 08 194 27 50	4936.8 1221.9	5398.7 1336.2	3.07 0.76
Ferry Hill.....	41 18 55.58	72 21 36.44	199 16 15 138 29 00	Nickerson..... Essex.....	19 17 46 318 27 46	9672.4 3932.8	10577.5 4300.8	6.01 2.44
Bog-hole Hill.....	41 18 47.40	72 18 36.32	93 27 36 173 57 59	Ferry Hill..... Nickerson.....	273 25 37 353 57 31	4196.7 9434.2	4589.4 10317.0	2.61 5.86
Lay's Hill.....	41 16 55.89	72 17 41.51	169 58 42 124 03 13	Nickerson..... Ferry Hill.....	349 57 38 304 00 38	13020.3 6596.0	14238.6 7223.2	8.09 4.10
Beacon Hill.....	41 17 32.28	72 23 48.34	208 07 47 252 15 51	Nickerson..... Bog-hole Hill.....	28 10 45 72 19 17	13269.2 7619.1	14512.8 8332.0	8.24 4.73

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lyme Spire.....	41 18 44.09	72 19 35.53	39 04 50 349 36 01	Cornfield Point..... Brown's Hill.....	219 02 39 169 37 33	7319.6 18039.0	8004.6 19726.9	4.55 11.21
Saybrook Spire.....	41 17 09.95	72 22 13.56	334 55 44 73 27 24	Brown's Hill..... Hammonasset.....	154 59 00 253 20 44	16378.9 14727.2	17911.5 16105.2	10.18 9.15
Saybrook Old Light-house...	41 16 15.24	72 20 16.40	115 44 01 73 25 01	Beacon Hill..... Cornfield Point.....	295 41 41 253 23 17	5474.0 3822.0	5986.2 4179.6	3.40 2.37
Saybrook New Light-house...	41 16 14 98	72 20 16.42	115 50 01 73 31 55	Beacon Hill Cornfield Point	295 46 20 253 30 11	5477.3 3819.0	5989.8 4176.4	3.40 2.37
North side of Long Island Sound, from Connecticut River to Housatonic River.								
High Hill.....	41 20 35.22	72 37 21.54	326 19 03 50 14 58	Hammonasset..... Sachem's Head.....	146 22 22 230 11 07	12659.9 10558.0	13844.5 11545.9	7.87 6.56
Murdock.....	41 17 08.13	72 28 00.43	55 31 44 116 08 01	Hammonasset High Hill.....	235 28 53 296 01 50	7328.5 14529.2	8014.2 15888.7	4.55 8.03
North Killingworth Spire....	41 21 44.75	72 33 37.62	351 53 11 282 28 47	Hammonasset..... Williams	171 54 02 102 30 38	12810.8 4011.5	14009.5 4386.9	7.96 2.49
Pachaag, (West Brook spire.)	41 17 08.28	72 26 40.23	318 18 48 62 18 27	Brown's Hill..... Hammonasset	138 25 00 242 14 43	19785.8 8932.5	21637.2 9768.3	12.29 5.55
Duck Island.....	41 15 21.29	72 28 12.66	81 34 39 161 38 50	Hammonasset Williams	261 31 56 341 37 07	5820.0 11548.8	6364.6 12629.4	3.62 7.18

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

236

S. Doc. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Great Hammock.....	41 15 32.85	72 30 22.86	66 03 09 133 48 00	Hammonasset High Hill.....	246 01 52 313 43 24	2982.7 13485.0	3261.8 14746.8	1.85 8.38
Long Hill.....	41 17 23.97	72 30 26.60	29 38 11 358 32.44	Hammonasset Great Hammock.....	209 36 56 178 32 46	5336.5 3428.8	5835.8 3749.6	3.32 2.13
Horse Pond.....	41 17 33.82	72 35 00.46	322 54 21 272 42 19	Hammonasset Long Hill.....	142 56 07 92 45 20	6195.5 6378.6	6775.2 6975.5	3.85 3.96
Camp's Hill.....	41 16 28.03	72 33 52.96	323 22 43 289 10 34	Hammonasset Great Hammock.....	143 23 44 109 12 53	3629.8 5177.6	3969.4 5662.1	2.26 3.22
Cow Hill.....	41 17 42.02	72 32 09.16	2 45 51 328 09 15	Hammonasset Great Hammock.....	182 45 44 148 10 25	5201.7 4690.1	5688.4 5129.0	3.23 2.91
Clinton Spire.....	41 16 40.30	72 31 04.04	28 13 56 106 43 26	Hammonasset Horse Pond.....	208 13 06 286 40 50	3736.4 5743.3	4086.0 6280.7	2.32 3.57
Tucks' Island.....	41 15 55.51	72 35 47.88	291 31 07 165 50 17	Hammonasset High Hill.....	111 33 24 345 49 15	5203.5 8898.7	5690.4 9731.4	2.23 5.53
Hogshead Point.....	41 16 08.22	72 37 54.83	286 25 21 185 22 07	Hammonasset High Hill.....	106 29 02 5 22 29	8127.9 8272.4	8888.4 9046.4	5.05 5.14
Griswold.....	41 17 27.86	72 39 15.85	296 08 35 204 41 30	Hammonasset High Hill.....	116 13 09 24 42 46	10785.9 6361.5	11795.1 6956.7	6.70 3.94
Mulberry Point.....	41 15 35.12	72 40 35.08	276 17 56 205 55 03	Hammonasset High Hill.....	96 23 23 25 57 11	11596.7 10293.4	12681.8 11256.6	7.21 6.40
Hungry Hill.....	41 18 47.51	72 41 12.64	300 09 25 233 15 08	Hammonasset High Hill.....	120 15 17 58 17 41	14342.6 6317.7	15684.6 6908.9	8.91 3.93

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.	Distance.	Distance.
					°	'	"			
Graves.....	41 17 50.46	72 36 31.21	167 02 05 105 04 24	High Hill..... Hungry Hill.....	347 01 32 285 01 18			5215.2 6778.7	5703.2 7413.0	Miles. 3.24 4.21
Bartlett.....	41 14 51.71	72 42 24.45	269 42 32 164 26 36	Hammonasset..... Sachem's Head.....	89 49 11 344 26 06			14073.2 3986.1	15390.0 4359.1	8.74 2.48
Madison Spire.....	41 16 42.43	72 35 47.91	163 08 15 117 05 06	High Hill..... Hungry Hill.....	343 07 13 297 01 32			7503.7 8482.8	7205.8 9276.5	4.66 5.27
Moose Hill	41 18 20.19	72 44 13.81	246 28 43 330 20 02	High Hill..... Sachem's Head.....	66 33 15 150 20 44			10452.9 2981.3	11431.2 3260.3	6.50 1.85
Setauket	41 19 34.11	72 46 11.76	319 05 21 261 16 30	Sachem's Head..... High Hill.....	139 07 21 81 21 20			6443.9 12471.1	7046.9 13637.9	4.01 7.75
Plant	41 16 36.71	72 50 09.53	266 26 00 225 16 57	Sachem's Head..... Setauket	86 30 36 45 19 34			9771.4 7780.6	10685.7 8308.6	6.07 4.83
Indian Neck.....	41 15 21.41	72 48 59.45	250 10 19 206 34 20	Sachem's Head..... Setauket	70 14 09 26 36 11			8633.7 8716.8	9441.6 9532.4	5.37 5.42
Barker.....	41 15 13.44	72 48 13.89	245 48 09 199 27 01	Sachem's Head..... Setauket	65 51 29 19 28 22			7741.9 8528.2	8466.0 9325.2	4.81 5.30
Hoadley's Point.....	41 15 25.13	72 43 49.68	104 03 25 198 01 12	Plant..... Sachem's Head.....	283 59 14 18 01 38			9112.2 2954.2	9964.8 3230.6	5.66 1.84
Stony Creek.....	41 16 20.92	72 45 00.92	247 02 59 196 35 04	Sachem's Head..... Moose Hill.....	67 04 12 16 35 35			2792.8 3839.0	3054.1 4198.2	1.74 2.39
Page 3.....	41 19 20.55	72 47 51.58	304 13 11 32 25 30	Sachem's Head..... Plant	124 16 17 212 23 59			7912.5 5986.7	8652.9 6546.9	4.92 3.72

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
North Guilford Spire.....	41 22 03.47	72 43 19.08	334 03 07 10 28 24	Hungry Hill..... Moose Hill.....	154 04 31 190 27 48	6721.7 7004.9	7350.7 7660.3	4.18 4.35
Branford Spire.....	41 16 18.24	72 49 46.34	244 02 17 328 05 26	Moose Hill..... Indian Neck.....	64 05 56 148 05 57	8602.8 2065.2	9407.8 2258.4	5.35 1.28
Falkner's Island Light-house.	41 12 40.78	72 38 54.02	245 54 23 309 37 51	Hammonasset..... Horton's Point.....	65 58 43 129 46 00	10050.1 22455.3	10990.5 24556.4	6.24 13.95
South Milford.....	41 13 24.01	73 00 55.22	101 58 38 205 22 17	Tashua Hill..... Mount Carmel.....	281 49 34 25 27 27	19652.6 25458.3	21491.5 27840.4	11.20 15.82
West Rock.....	41 19 54.03	72 57 22.35	71 49 37 22 24 03	Tashua Hill..... South Milford.....	251 38 11 202 21 41	25448.9 13010.8	27830.1 14228.2	15.81 8.08
Fort Wooster.....	41 16 53.32	72 53 14.89	269 34 49 134 06 17	Sachem's Head..... West Rock.....	89 41 28 314 03 34	14067.0 8013.3	15383.2 8763.1	8.74 4.98
East Rock.....	41 19 35.03	72 53 57.14	348 50 57 97 01 24	Fort Wooster..... West Rock.....	168 51 25 276 59 08	5084.4 4807.7	5560.2 5257.6	3.16 2.99
Hemmingway.....	41 18 55.79	72 51 52.06	27 01 45 112 36 33	Fort Wooster..... East Rock.....	207 00 50 292 35 10	4241.1 3150.5	4637.9 3445.3	2.63 1.96
Great Rock.....	41 20 29.16	72 50 50.98	26 42 08 68 55 20	Fort Wooster..... East Rock.....	206 40 33 248 53 17	7452.2 4639.2	8149.5 5073.2	4.63 2.88
Mile Rock.....	41 16 45.80	72 51 27.38	125 08 38 64 50 32	West Rock..... South Milford.....	305 04 44 244 44 17	10094.7 14613.0	11039.3 15980.3	6.27 9.08
East Haven Spire.....	41 16 39.39	72 51 59.40	103 44 55 153 11 41	Fort Wooster..... East Rock.....	283 44 05 333 10 23	1808.3 6070.9	1977.5 6639.0	1.12 3.77

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2

Name of station.	Latitude ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.		Distance. Metres.	Distance. Yards.	Distance. Miles.
					° ' "	° ' "			
Morgan's Point.....	41 14 30.28	72 53 19.22	79 08 53 181 19 01	South Milford..... Fort Wooster.....	259 03 52 1 19 04	259 03 52 1 19 04	10813.9 4412.8	11825.7 4825.7	6.72 2.74
Dragon Spire.....	41 17 57.15	72 51 33.35	50 11 45 166 28 23	Fort Wooster..... Hemmingway	230 10 38 346 28 11	230 10 38 346 28 11	3075.4 1860.4	3363.1 2034.5	1.91 1.15
New Haven Light-house.....	41 14 54.01	72 53 54.85	74 12 21 152 28 02	South Milford..... West Rock.....	254 07 42 332 25 45	254 07 42 332 25 45	10175.4 10438.1	11127.4 11414.7	6.31 6.49
Jones.....	41 15 35.40	72 58 05.54	250 24 34 187 10 19	Fort Wooster..... West Rock.....	70 27 45 7 10 47	70 27 45 7 10 47	7178.1 8041.0	7849.7 8793.4	4.46 5.00
Jeremy North.....	41 16 11.10	72 55 42.91	71 39 24 161 24 50	Jones..... West Rock.....	251 37 50 341 23 44	251 37 50 341 23 44	3497.7 7255.2	3824.9 7934.1	2.17 4.51
Jeremy South.....	41 15 37.04	72 55 42.68	163 42 08 89 08 07	West Rock..... Jones.....	343 41 02 269 06 33	343 41 02 269 06 33	8259.0 3325.0	9031.8 3636.2	5.13 2.06
Pond Point.....	41 12 38.82	73 00 17.98	209 30 11 221 21 21	Jones..... Jeremy South.....	29 31 39 49 24 23	29 31 39 49 24 23	6259.2 8444.9	6844.8 9235.0	3.89 5.25
Oyster River Point.....	41 13 59.78	72 58 12.87	49 24 35 73 45 08	Pond Point..... South Milford.....	229 23 13 253 43 37	229 23 13 253 43 37	3837.5 3940.1	4196.5 4308.7	2.38 2.45
Allen.....	41 17 37.87	72 58 03.64	281 32 08 0 40 02	Fort Wooster..... Jones.....	101 35 18 180 40 01	101 35 18 180 40 01	6857.1 3778.3	7498.7 4131.8	4.26 2.35
Prindle	41 16 02.71	72 59 12.38	26 05 17 259 20 27	South Milford..... Fort Wooster.....	206 04 09 79 24 23	206 04 09 79 24 23	5450.3 8463.0	5960.2 9254.8	3.39 5.26
Fort Hale, or Mosquito Fort.	41 16 10.90	72 54 00.99	66 11 48 145 46 42	Jeremy South..... West Rock.....	246 10 42 325 44 29	246 10 42 325 44 29	2587.0 8325.4	2829.0 9104.5	1.61 5.17

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Brewster's Factory Cupola, (New Haven.)	41 18 07.10	72 54 18.41	48 29 48 127 39 01	Jones..... West Rock.....	228 27 19 307 37 00	7058.9 5401.8	7719.4 5907.2	4.39 3.36
College Spire, (New Haven).	41 18 27.74	72 55 24.15	35 14 54 134 05 03	Jones..... West Rock.....	215 13 07 314 03 45	6509.0 3826.2	7118.0 4184.2	4.04 2.38
Episcopal Church, (New Ha- ven.)	41 18 11.32	72 54 53.55	13 30 36 132 29 12	Jeremy South..... West Rock.....	193 30 03 312 27 33	4894.0 4692.0	5351.9 5131.0	3.04 2.91
West Haven Spire.....	41 16 15.27	72 56 42.73	57 27 52 143 32 42	Jones..... Allen	237 26 58 323 31 49	2286.4 3168.3	2500.3 3464.5	1.42 1.97
Benham's Chimney	41 15 05.46	72 58 34.48	216 07 22 75 26 37	Jones..... Gunn	36 07 42 255 22 38	1142.0 8740.0	1248.9 9557.8	0.71 5.43
North Milford Spire.....	41 16 39.82	73 01 15.20	291 48 26 222 05 35	Prindle..... West Rock.....	111 49 49 42 08 09	3079.0 8076.0	3367.1 8831.7	1.91 5.02
Hicock, (2).....	41 23 10.04	72 59 53.26	329 51 58 4 33 15	West Rock..... South Milford.....	149 53 37 184 33 11	6989.8 18133.9	7643.8 19830.7	4.34 11.27
Hillhouse.....	41 19 38.22	72 59 28.30	260 31 57 174 55 37	West Rock..... Hicock, (2).....	80 33 20 354 55 21	2969.0 6559.4	3246.8 7172.8	1.84 4.08
LONG ISLAND.								
Eastern part.								
Montauk Point.....	41 04 14.68	71 51 34.60	78 11 28 181 53 17	Montauk..... Watch Hill.....	258 09 54 1 53 44	3411.7 26943.0	3731.0 29464.0	2.12 16.74
Montauk Light-house.....	41 04 13.27	71 51 06.36	80 42 10 180 29 25	Montauk..... Watch Hill.....	260 40 17 0 29 32	4052.2 26972.5	4431.4 29495.8	2.52 16.76

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
						Metres.	Yards.	Miles.
Fort Pond.....	41 01 43.57	71 58 39.39	127 25 48 238 18 42	Gardiner's Island..... Montauk.....	307 20 57 58 21 49	13189.8 7548.3	14423.9 8254.5	8.19 4.69
Napeague.....	41 00 21.28	72 01 17.14	147 49 22 236 32 05	Gardiner's Island..... Fort Pond.....	327 46 15 56 33 48	12464.3 4603.4	13630.6 5034.1	7.74 2.86
Napeague Beach.....	40 58 46.55	72 05 13.67	175 15 07 242 07 15	Gardiner's Island..... Napeague.....	355 14 35 62 09 50	13516.4 6253.3	14781.1 6838.4	8.40 3.88
Amagansett.....	40 59 16.13	72 07 54.31	191 49 36 257 45 02	Gardiner's Island..... Napeague.....	11 50 50 77 49 23	12800.4 9497.5	13998.1 10386.2	7.95 5.90
Accabonock.....	41 00 44.65	72 07 15.07	189 53 37 274 53 49	Gardiner's Island..... Napeague.....	9 54 25 94 57 43	9975.1 8394.9	10908.5 9180.4	6.20 5.21
Hog Creek Point.....	41 03 10.27	72 09 13.51	134 33 11 219 59 32	Brown's Hill..... Gardiner's Island.....	314 27 54 40 02 18	15781.5 6966.0	17258.2 7617.8	9.81 4.33
Cedar Point.....	41 02 37.07	72 13 44.63	157 50 01 109 11 44	Brown's Hill..... Shelter Island.....	337 47 43 289 06 45	13053.3 11235.9	14274.7 12287.2	8.11 6.98
Gardiner's Point.....	41 08 31.62	72 08 20.67	324 40 29 34 41 13	Gardiner's Island..... Cedar Point.....	144 42 00 214 37 39	5610.1 13295.5	6135.0 14539.6	3.49 8.26
Ram Head.....	41 04 43.04	72 16 25.39	171 50 00 88 22 01	Brown's Hill..... Shelter Island.....	351 49 27 268 18 20	8285.1 6862.4	9060.3 7504.5	5.15 4.26
Cleave's Point.....	41 06 52.60	72 19 59.75	308 36 19 222 15 19	Ram Head..... Brown's Hill.....	128 38 40 42 17 07	6402.3 5681.9	7001.4 6213.6	3.98 3.53
Hay Beach Point.....	41 06 17.06	72 19 38.55	212 06 24 155 43 21	Brown's Hill..... Cleave's Point.....	32 07 58 335 43 08	6244.4 1202.7	6828.7 1315.2	3.88 0.75

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.		Distance. Metres.	Distance. Yards.	Distance. Miles.
					° ' "	° ' "			
Long Beach	41 07 04.45	72 17 05.14	176 15 39 84 53 28	Brown's Hill..... Cleave's Point.....	356 15 32 264 51 33	3847.3 4090.2	4207.3 4472.9	2.39 2.54	
Oyster Pond.....	41 09 30.88	72 13 48.46	131 55 05 82 02 25	Cornfield Point..... Brown's Hill	311 48 35 262 00 09	17055.9 4882.9	18651.8 5339.8	10.60 3.03	
Conkling	41 06 14.22	72 22 54.87	235 41 38 180 04 50	Brown's Hill..... Cornfield Point.....	55 45 21 0 04 50	9568.1 17449.4	10463.4 19082.1	5.95 10.84	
Rocky Point.....	41 08 13.53	72 20 53.34	251 21 34 168 29 50	Brown's Hill..... Cornfield Point	71 23 57 348 27 59	5350.2 14052.4	5850.8 15367.3	3.32 8.73	
Southold Spire.....	41 03 44.09	72 25 31.33	229 02 12 146 54 15	Brown's Hill..... Horton's Point.....	49 07 38 326 53 02	15297.4 2642.3	16728.8 2889.5	9.50 1.64	
Hog Neck.....	41 01 22.10	72 19 16.77	122 56 26 154 31 40	Horton's Point..... Shelter Island.....	302 51 45 334 30 20	12135.2 6645.5	13270.7 7267.3	7.54 4.13	
Smith's Farm.....	41 00 00.10	72 16 00.72	138 56 01 118 55 33	Shelter Island..... Hog Neck.....	318 52 37 298 53 24	11316.8 5232.7	12375.7 5722.3	7.03 3.25	
Cedar Island.....	41 02 23.74	72 15 18.24	71 10 55 12 37 46	Hog Neck..... Smith's Farm.....	251 08 18 192 37 17	5886.9 4540.3	6437.7 4965.1	3.66 2.82	
Cedar Island Light-house....	41 02 25.61	72 15 18.92	12 16 37 70 35 58	Smith's Farm..... Hog Neck.....	192 16 10 250 33 22	4593.0 5891.0	5022.8 6442.2	2.85 3.66	
Sag Harbor Spire.....	40 59 53.23	72 17 20.73	135 19 42 263 31 28	Hog Neck..... Smith's Farm.....	315 18 26 83 32 21	3855.7 1881.8	4216.5 2057.9	2.40 1.17	
Flanders	40 54 03.44	72 36 22.80	195 35 42 128 17 19	Mattituck Hills..... Friar's Head	15 37 10 308 12 45	11612.1 12455.4	12698.7 13620.9	7.21 7.74	

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.	Distance.
Southport	° ' " 40 54 49.90	° ' " 72 33 22.39	° ' " 173 35 54 71 16 10	Mattituck Hills	° ' " 353 35 23 251 14 12	Metres. 9812.4 4458.3	Yards. 10730.6 4875.5	Miles. 6.10 2.77	
Holmes' Hill.....	40 56 48.05	72 25 03.52	115 37 48 72 42 10	Mattituck Hills	295 31 50 252 36 43	14143.3 12226.0	15466.7 13370.0	8.79 7.60	
Noyack	40 59 22.43	72 21 56.55	94 33 33 42 34 07	Mattituck Hills	274 25 28 222 32 04	17174.9 6463.9	18782.0 7068.7	10.67 4.02	
Great Hog Neck.....	41 01 45.02	72 23 19.30	336 15 49 277 05 12	Noyack.....	156 16 43 97 07 43	4804.3 5711.1	5253.8 6245.5	2.99 3.55	
Jessup's Neck	41 00 49.18	72 22 11.06	352 46 47 255 59 15	Noyack	172 46 57 76 01 06	2697.3 4198.4	2949.7 4591.3	1.68 2.61	
Reeves	40 58 56.35	72 30 34.09	27 23 27 297 05 00	Southport	207 21 24 117 08 37	8559.9 8683.6	9360.9 9496.1	5.32 5.40	
Little Hog Neck	40 59 25.32	72 25 55.77	82 12 24 345 51 39	Reeves	262 09 22 165 52 13	6566.5 5002.2	7180.9 5470.3	4.08 3.11	
Robbin's Island.....	40 57 47.34	72 27 26.28	298 41 56 249 08 25	Holmes' Hill	118 43 30 69 11 57	3806.9 8247.6	4163.1 9019.3	2.37 5.13	
Mattituck, (flag-staff).....	40 59 25.24	72 31 44.65	15 04 18 298 23 17	Southport	195 03 14 118 24 07	8795.0 1874.7	9618.0 2050.1	5.47 1.67	
Shinnecock.....	40 53 00.46	72 27 52.57	209 23 03 146 10 15	Holmes' Hill	29 24 54 326 06 08	8057.8 15808.7	8811.8 17287.9	5.01 9.82	
Manor	41 01 36.72	72 31 44.81	50 20 50 341 08 59	Mattituck Hills	230 19 15 161 11 23	4382.3 16824.8	4792.4 18399.1	2.72 10.45	

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Brown's Point	40 56 50.89	72 33 10.35	270 23 50 313 40 47	Holmes' Hill	90 29 02	11386.2	12451.6	7.07
Upper Aquebogue	40 56 45.31	72 36 58.32	305 09 22 350 32 47	Shinnecock	133 44 15	10286.2	11248.7	6.39
Indian Island	40 55 34.08	72 36 34.26	286 51 47 354 30 53	Southport	125 11 35	6180.0	6758.3	3.84
James Port Spire	40 56 17.70	72 34 22.77	332 26 57 34 09 12	Flanders	170 33 10	5061.6	5535.2	3.15
Osborn Hill	40 52 46.43	72 42 17.90	171 41 07 220 05 14	Southport	106 53 45	4691.5	5130.5	2.92
Riverhead Court-house	40 54 59.24	72 39 25.95	137 28 44 44 30 24	Flanders	174 31 01	2807.9	3070.6	1.75
Luce's Landing	40 58 40.68	72 37 26.41	307 58 05 31 59 46	Southport	152 27 28	3054.8	3340.6	1.90
Franklinville	40 57 49.84	72 33 38.14	170 11 59 52 27 56	Flanders	214 07 54	5003.6	5471.8	3.11
Old Landing	40 58 40.94	72 40 34.52	12 29 07 77 42 45	Friar's Head	351 40 25	10193.2	11147.0	6.33
Good Ground	40 52 18.17	72 33 50.24	261 07 09 178 14 27	Mattituck Hills	40 10 34	17733.8	19393.2	11.02
Inlet West	40 49 41.46	72 31 05 55	216 20 57 141 25 38	Friar's Head	317 26 10	8129.1	8889.7	5.05
				Osborn Hill	224 28 32	5742.4	6279.7	3.57
				Shinnecock	128 04 12	17038.8	18633.1	10.59
				Osborn Hill	211 56 29	12879.9	14085.1	8.00
				Mattituck Hills	350 11 39	4263.2	4662.1	2.65
				Osborn Hill	232 22 15	15344.4	16780.2	9.53
				Friar's Head	192 27 53	11199.7	12247.7	6.96
				Shinnecock	257 40 56	3982.7	4355.4	2.48
				Mattituck Hills	81 11 03	8474.0	9266.9	5.27
				Shinnecock	358 14 12	14437.2	15788.1	8.97
				Good Ground	36 23 03	7621.8	8335.0	4.74
					321 23 50	6184.2	6762.9	3.84

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Inlet East.....	40 50 45.87	72 27 16.37	69 43 08 168 27 43	Inlet West..... Shinnecock.....	249 40 36 348 27 19	5724.3 4236.8	6259.9 4633.2	3.56 2.63
Cormorant Point.....	40 51 51.99	72 29 20.77	304 58 59 224 20 56	Inlet East..... Shinnecock.....	125 00 21 44 21 55	3556.2 2953.5	3889.0 3233.9	2.21 1.84
Ram Pasture.....	40 51 08.28	72 31 20.78	45 29 28 352 25 04	Quogue..... Inlet West.....	225 27 13 172 25 13	6793.5 2702.3	7429.2 2955.2	4.22 1.68
South Hampton.....	40 51 48.19	72 23 56.08	111 56 51 67 44 11	Shinnecock..... Inlet East.....	291 54 16 247 41 59	5969.2 5069.7	6527.7 5544.1	3.71 3.15
Great Hill.....	40 55 08.51	72 23 08.23	10 16 36 59 20 07	South Hampton..... Shinnecock.....	190 16 06 239 17 01	6279.3 7738.6	6866.9 8462.7	3.90 4.81
Bridge Hampton.....	40 53 46.39	72 18 33.10	64 17 17 111 30 06	South Hampton..... Great Hill.....	244 13 44 291 27 06	8394.1 6918.8	9179.5 7566.2	5.22 4.40
Drake's Hill.....	40 57 54.00	72 18 58.35	48 53 17 355 34 22	Great Hill..... Bridge Hampton.....	228 50 33 175 34 43	7759.6 7660.4	8485.7 8377.2	4.82 4.76
South Hampton Spire.....	40 53 01.16	72 23 02.28	257 29 33 212 15 57	Bridge Hampton..... Drake's Hill.....	77 32 27 32 18 30	6454.2 10684.7	7058.1 11684.5	4.01 6.64
Sag Beach.....	40 55 08.05	72 15 03.73	62 48 49 133 01 48	Bridge Hampton..... Drake's Hill.....	242 46 36 312 59 14	5508.9 7504.7	6024.4 8206.9	3.42 4.66
Barnes' Island.....	40 57 11.82	72 11 52.49	97 28 58 49 32 13	Drake's Hill..... Sag Beach.....	277 24 18 229 30 08	10042.7 5881.0	10982.4 6431.3	6.24 3.66
East Hampton Spire.....	40 57 27.08	72 11 05.78	56 59 44 94 20 26	Bridge Hampton..... Drake's Hill.....	236 54 55 274 15 16	12483.5 11080.6	13631.6 12117.4	7.76 6.88

United States Coast Survey.—Geographical Positions, Section II,—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude,	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Long Island, south side.								
Terry.....	40 51 03.02	72 45 43.82	50 02 16 88 12 19	Base East..... Ruland's Hill.....	229 51 00 268 01 55	31738.5 22360.5	34708.3 24452.8	19.72 13.89
Ketchabonock.....	40 47 34.18	72 38 25.40	150 31 16 122 07 17	Osborn Hill..... Terry.....	330 28 51 302 02 37	11065.3 12126.7	12100.1 13261.4	6.87 7.53
Quogue.....	40 48 33.83	72 34 47.50	126 28 59 70 12 12	Osborn Hill..... Ketchabonock.....	306 24 06 250 09 47	13115.2 5427.6	14342.4 5935.5	8.15 3.37
Foster.....	40 48 50.92	72 35 59.19	55 22 29 287 25 03	Ketchabonock..... Quogue.....	235 20 35 107 25 50	4164.1 1760.7	4553.7 1925.5	2.59 1.09
Moriches.....	40 46 17.41	72 43 07.49	185 31 30 157 25 54	Osborn Hill..... Terry.....	5 32 05 337 24 12	12055.5 9541.0	13183.5 10433.8	7.49 5.93
Speonk.....	40 47 45.67	72 41 29.73	274 39 10 40 06 48	Ketchabonock..... Moriches.....	94 41 35 220 05 33	4336.1 3559.3	4741.8 3892.4	2.69 2.21
Oliver.....	40 46 58.24	72 44 51.79	297 13 55 252 49 03	Moriches..... Speonk.....	117 14 50 72 51 15	2750.1 4957.8	2927.4 5421.7	1.71 3.08
Floyd.....	40 45 29.92	72 48 41.47	243 08 47 202 02 30	Oliver..... Terry.....	63 11 29 22 04 26	6035.5 11085.8	6600.3 12123.1	3.75 6.89
Head and Horns.....	40 39 49.23	73 03 39.47	73 17 23 188 04 40	Base West..... Ruland's Hill.....	253 11 36 8 05 59	13059.0 20249.3	14280.9 22144.0	8.11 12.58
Watch Hill.....	40 41 26.98	72 58 52.83	65 53 46 167 12 14	Head and Horns..... Ruland's Hill.....	245 50 39 347 10 26	7375.4 17467.6	8065.5 19102.0	4.58 10.85

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Belleville Beach	40 42 43.67	72 55 27.35	149 23 14 63 53 45	Ruland's Hill..... Watch Hill.....	329 19 12 243 51 29	17048.0 5372.0	18643.2 5874.7	10.59 3.34
Blue Point	40 43 42.09	73 01 44.21	20 39 12 315 59 44	Head and Horns..... Watch Hill.....	200 37 57 136 01 36	7675.0 5791.8	8393.2 6333.7	4.77 3.60
Patchogue	40 44 48.25	72 59 50.03	52 42 36 347 47 37	Blue Point..... Watch Hill.....	232 41 22 167 48 14	3367.6 6351.3	3682.7 6945.6	2.09 3.95
Howell's Point.....	40 44 23.04	72 56 24.92	80 27 29 32 36 08	Blue Point..... Watch Hill.....	260 24 00 212 34 32	7597.0 6444.9	8307.9 7047.9	4.72 4.01
Ketchum.....	40 45 22.81	72 54 10.17	59 45 43 20 15 29	Howell's Point..... Belleville Beach.....	239 44 15 200 14 39	3659.0 5231.6	4001.4 5721.1	2.27 3.25
Smith's Point.....	40 44 24.51	72 52 33.52	52 41 24 128 25 11	Belleville Beach..... Ketchum.....	232 39 31 308 24 08	5129.8 2893.7	5609.8 3164.5	3.19 1.80
Smith's Beach	40 44 07.47	72 50 56.40	67 54 03 93 35 41	Belleville Beach..... Howell's Point.....	247 51 06 273 32 07	6863.8 7722.6	7506.1 8445.2	4.27 4.80
Wm. Smith.....	40 45 18.63	72 52 33.48	40 29 50 93 15 27	Belleville Beach..... Ketchum.....	220 27 57 273 14 24	6283.6 2271.4	6871.6 2483.9	3.91 1.41
Belleport Spire.....	40 45 18.08	72 56 03.91	349 47 13 288 29 21	Belleville Beach..... Smith's Point.....	169 47 37 108 31 38	4839.0 5204.5	5291.8 5691.5	3.01 3.23
Charles Osborn	40 45 40.01	72 55 40.27	356 48 40 297 58 43	Belleville Beach..... Smith's Point.....	176 48 48 118 00 45	5447.4 4960.9	5957.1 5425.1	3.39 3.08
Brown's Point	40 43 23.37	73 03 47.03	358 27 39 258 39 26	Head and Horns..... Blue Point	178 27 44 78 40 46	6607.0 2939.2	7225.2 3214.2	4.11 1.83

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

248

S. Doc. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.		
					° ' "			Metres.	Yards.	Miles.
Green's Point.....	40 43 01.13	73 06 03.45	257 53 55 330 15 28	Brown's Point Head and Horns	77 55 24 150 17 02	3273.9 6816.1	3580.2 7453.9	2.94 4.24		
Nicoll's Point.....	40 41 52.23	73 08 36.58	239 23 21 298 30 39	Green's Point..... Head and Horns	59 25 01 118 33 53	4175.5 7941.0	4655.7 8684.0	2.64 4.93		
Morris	40 43 45.04	73 06 52.06	35 11 31 319 53 27	Nicoll's Point..... Green's Point.....	215 10 27 139 53 59	4257.3 1770.6	4655.7 1936.3	2.64 1.10		
Seaman	40 43 15.18	73 08 39.28	276 44 31 249 53 08	Green's Point..... Morris	96 46 13 69 54 17	3682.8 2679.6	4037.4 2930.3	2.29 1.67		
Jones.....	40 38 42.79	73 09 13.10	188 20 47 209 10 55	Nicoll's Point..... Green's Point.....	8 21 11 29 12 59	5905.3 9127.9	6457.9 9982.0	3.67 5.67		
Baberry Island.....	40 42 18.43	73 12 31.52	324 58 01 278 18 53	Jones..... Nicoll's Point.....	145 00 10 98 21 26	8120.7 5573.8	8880.6 6095.4	5.05 3.47		
Conklin's Point.....	40 41 02.43	73 16 23.89	246 43 31 317 49 32	Baberry Island..... Base West	66 46 03 97 51 43	5937.2 8124.8	6492.7 8885.0	3.69 5.05		
Cumpaum	40 42 19.84	73 15 05.93	270 40 39 37 28 32	Baberry Island..... Conklin's Point.....	90 42 20 217 27 41	3624.5 3008.4	3963.6 3289.9	2.25 1.87		
Thurber's Neck.....	40 43 10.38	73 13 51.28	310 33 35 48 20 47	Baberry Island..... Cumpaum	130 34 27 228 19 58	2464.1 2345.0	2694.7 2564.4	1.53 1.46		
Fire Island Light-house	40 37 53.17	73 12 50.67	139 31 04 213 40 44	West Hills	319 23 00 33 48 03	26767.4 28412.9	29272.0 31071.5	16.63 17.66		
Oak Island Inlet	40 38 12.77	73 16 36.13	183 08 43 277 49 03	Conklin's Point..... Base West	3 08 51 97 51 43	5240.3 5796.3	5730.6 6338.7	3.26 3.61		

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. O ' "	Longitude. O ' "	Azimuth. O ' "	To station—	Back azimuth. O ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Sampawam's Creek.....	40 40 47.63	73 18 34.71	261 32 19 329 44 34	Conklin's Point..... Oak Island Inlet	81 33 44 149 45 51	3105.2 5528.8	3395.8 6046.1	1.93 3.44
Fleet's Point.....	40 40 03.31	73 20 39.33	244 57 13 300 48 22	Sampawam's Creek..... Oak Island Inlet	64 58 34 120 51 00	3229.9 6652.7	3532.1 7275.2	2.01 4.13
Oak Island Beach.....	40 37 33.00	73 20 25.80	257 10 21 176 04 43	Oak Island Inlet	77 12 51	5534.2	6052.0	3.44
Oak Island	40 38 26.84	73 17 36.50	162 31 37 124 43 51	Fleet's Point	356 04 35	4646.9	5081.7	2.89
Oak Island	40 38 26.84	73 17 36.50	162 31 37 124 43 51	Sampawam's Creek..... Fleet's Point	342 30 59 304 41 52	4552.5 5224.8	4978.5 5713.7	2.83 3.25
Cedar Island	40 38 59.73	73 20 18.46	216 12 06 165 58 08	Sampawam's Creek..... Fleet's Point	36 13 14 345 57 54	4124.8 2021.5	4510.8 2210.7	2.56 1.26
Babylon	40 41 31.44	73 18 57.66	338 15 20 283 54 26	Sampawam's Creek..... Conklin's Point	158 15 35 103 56 06	1454.5 3719.3	1590.6 4067.3	0.90 2.31
Munsey	40 40 46.38	73 20 54.29	269 18 41 345 10 55	Sampawam's Creek..... Fleet's Point	89 20 12 165 11 05	3277.8 1373.8	3584.5 1502.4	2.04 0.85
Half Neck	40 39 20.64	73 23 16.16	250 19 30 309 39 39	Fleet's Point	70 21 12	3911.4	4277.4	2.43
Gilgo Inlet	40 36 43.52	73 23 36.82	251 12 40 185 43 11	Oak Island Beach..... Half Neck	129 41 30 71 14 44 5 43 25	5200.2 4741.5 4870.1	5686.8 5185.2 5325.8	3.23 2.95 3.03
Uncaway.....	40 38 58.40	73 25 31.60	327 02 01 257 49 04	Gilgo Inlet	147 03 15	4957.5	5421.4	3.08
High Hill.....	40 36 10.72	73 28 16.48	261 13 33 216 49 38	Half Neck	77 50 32	3254.5	3559.0	2.02
				Gilgo Inlet	81 16 35	6650.9	7273.2	4.13
				Uncaway	36 51 25	6461.9	7066.5	4.02

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Jones' Beach East	40 36 46.87	73 25 02.52	76 16 28 170 26 28	High Hill	256 14 22	4693.6	5112.8	2.92
				Uncaway	350 26 09	4113.5	4498.4	2.56
Brick-house Point	40 39 12.32	73 27 26.12	11 56 07 279 03 23	High Hill	191 55 35	5724.3	6259.8	3.56
				Uncaway	99 04 38	2724.2	2979.1	1.69
Little Neck	40 39 20.90	73 31 06.71	325 41 31 272 54 11	High Hill	145 43 21	7099.4	7763.7	4.41
				Brick-house Point	92 56 35	5188.1	5673.6	3.22
New Inlet	40 35 51.76	73 32 54.24	264 51 20 201 23 01	High Hill	84 54 21	6555.8	7169.2	4.07
				Little Neck	21 24 11	6927.6	7575.8	4.30
Lines' Island	40 37 58.02	73 28 18.49	208 13 24 122 54 57	Brick-house Point	28 14 03	2601.1	2844.5	1.62
				Little Neck	302 52 54	4706.6	5147.0	2.92
Jones' Beach West	40 35 37.92	73 30 09.92	249 12 51 169 01 27	High Hill	69 14 05	2851.4	3118.2	1.77
				Little Neck	349 00 50	7005.3	7660.8	4.35
Great Island	40 37 36.46	73 30 10.93	232 37 13 157 52 17	Brick-house Point	52 39 00	4872.0	5327.9	3.03
				Little Neck	337 51 41	3477.6	3803.0	2.16
Raynor	40 38 22.96	73 34 04.49	340 29 54 246 49 13	New Inlet	160 30 40	4947.0	5409.9	3.07
				Little Neck	66 51 09	4542.6	4967.7	2.82
Titus	40 37 11.81	73 37 41.44	290 03 48 246 41 28	New Inlet	110 06 55	7188.1	7860.7	4.47
				Raynor	66 43 50	5550.2	6069.5	3.45
Long Beach East	40 35 18.91	73 34 28.48	245 24 56 185 40 19	New Inlet	65 25 59	2436.4	2664.4	1.52
				Raynor	5 40 34	5704.6	6238.4	3.55
Blue Hole	40 36 53.49	73 34 27.00	97 04 10 190 50 54	Titus	277 02 03	4604.7	5035.6	2.87
				Raynor	10 51 09	2809.9	3072.8	1.75

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Long Beach	40 35 08.02	73 36 33.95	255 20 36 210 17 01	New Inlet..... Raynor	75 22 59 30 18 38	5339.0 6963.6	5838.6 7615.2	3.32 4.33
Gentleman's Hill	40 34 59.79	73 39 05.36	205 50 41 259 33 33	Titus	25 51 36	4524.4	4947.8	2.81
Near Rockaway.....	40 38 00.53	73 39 29.03	300 42 47 354 17 54	New Inlet..... Titus	79 37 34 120 43 57	8871.8 2941.2	9701.9	5.48
Hog Island	40 36 18.96	73 39 09.54	231 47 09 171 41 04	Gentleman's Hill..... Titus	174 18 10 51 48 06	5602.0 2635.4	6126.2	1.83
Pavilion	40 35 44.72	73 44 55.54	241 20 20	Near Rockaway..... Gentleman's Hill.....	351 40 51 99 34 53	3165.9 8348.6	3462.1	1.64
Hicks' Neck.....	40 36 51.49	73 42 28.82	305 44 36 243 13 52	Near Rockaway..... Gentleman's Hill.....	61 23 53 125 46 49	8742.6 5894.1	9560.7	5.19
Hicks' Beach.....	40 35 33.46	73 42 31.78	282 03 23 223 25 20	Near Rockaway..... Gentleman's Hill.....	63 15 49 102 05 37	4731.2 4963.3	5173.9	3.66
Howard, (Staten Island)	40 37 36.73	74 05 03.89	163 34 41 243 19 10	Weasel	43 27 19	6247.1	6831.6	2.94
Mount Prospect	40 40 15.73	73 57 41.40	140 54 53 64 47 02	Near Rockaway..... Weasel	343 30 54 63 36 48	28862.7 42542.3	31563.4	3.08
Flatlands	40 36 57.10	73 55 13.25	95 05 08 150 24 33	Howard	244 42 14	11493.6	12569.1	3.88
Coney Island East	40 34 30.78	73 55 56.16	114 03 33 192 36 01	Howard	320 46 16	29373.5	32122.0	17.93
				Mount Prospect.....	274 58 43	13934.9	15238.8	26.43
				Howard	330 22 58	7046.1	7705.4	18.25
				Howard	293 57 34	14096.0	15415.0	7.14
				Flatlands	12 36 24	4624.3	5057.0	8.66
								4.38
								8.76
								2.87

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Wyckoff.....	40 34 27.95	73 58 00.25	182 21 46 120 21 01	Mount Prospect..... Howard.....	2 21 56 300 16 25	10735.6 11536.6	11958.9 12616.1	6.67 7.17
Rockaway Beach.....	40 34 49.13	73 49 36.69	131 31 52 86 53 19	Mount Prospect..... Wyckoff.....	311 26 37 266 47 53	15206.5 11860.2	16629.4 12969.9	9.45 7.37
Barren Island.....	40 34 26.28	73 52 58.33	148 20 30 90 26 37	Mount Prospect..... Wyckoff.....	328 17 26 270 23 23	12665.8 7100.6	13850.9 7765.0	7.87 4.41
Canausey.....	40 37 44.69	73 52 59.46	64 58 46 318 37 24	Flatlands..... Rockaway Beach.....	244 57 17 138 39 36	3470.0 7214.0	3794.7 7889.0	2.16 4.48
Jamaica South.....	40 39 24.87	73 47 17.73	21 01 08 68 58 42	Rockaway Beach..... Canausey.....	200 59 37 248 54 59	9110.0 8603.1	9962.4 9408.1	5.66 5.35
Booraem.....	40 39 54.27	73 49 35.86	50 07 59 0 07 05	Canausey..... Rockaway Beach.....	230 05 36 180 07 04	6233.2 9412.2	6816.4 10292.9	3.87 8.09
New Lots, (spire).....	40 39 50.44	73 52 51.00	304 06 13 333 48 48	Pavilion..... Rockaway Beach.....	124 11 24 153 50 55	1350.3 10355.6	1476.7 11324.7	0.84 6.43
<i>Long Island, north side.</i>								
Glover.....	40 57 36.23	72 49 17.60	53 28 47 337 24 20	Ruland's Hill..... Terry.....	233 20 42 157 36 40	21581.1 13120.1	23600.4 14347.8	13.41 8.15
Fresh Pond.....	40 57 44.25	72 46 37.11	358 52 45 326 32 43	Friar's Head..... Osborn.....	78 54 54 146 35 34	4673.2 11006.9	500.5 12036.8	2.90 6.84
Hallock.....	40 57 10.90	72 55 11.85	36 48 58 310 25 27	Ruland's Hill..... Terry.....	216 45 43 130 32 35	15089.8 17478.2	16501.8 19113.6	9.38 10.86

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.			Distance.	Distance.	Distance.
					°	'	"			
Woodhull.	40 57 18.26	72 53 12.22	85 24 17 317 46 01	Hallock..... Terry.....	265 22 04 137 50 56			Metres. 2806.7 15622.3	Yards. 3069.3 17084.1	Miles. 1.74 9.71
Mount Sinai	40 56 38.90	73 01 52.42	358 15 19 294 28 36	Ruland's Hill..... Terry.....	178 15 29 114 39 03			11100.5 24925.3	12159.2 27257.6	6.90 15.49
Mount Pleasant	40 48 52.09	73 10 13.81	254 39 43 328 05 44	Ruland's Hill..... Base East.....	74 45 21 148 10 19			12528.3 19293.7	13700.6 21099.0	7.78 11.99
Little.....	40 52 57.49	73 12 53.02	285 02 16 333 45 27	Ruland's Hill..... Mount Pleasant.....	105 09 38 153 47 12			16371.8 8437.4	17903.7 9226.9	10.17 5.24
Blydenburgh.....	40 53 06.95	73 11 01.28	351 56 48 83 38 18	Mount Pleasant..... Little.....	171 57 22 263 37 07			7939.0 2632.2	8691.9 2878.5	4.93 1.64
Stony Brook.....	40 53 22.44	73 10 16.59	292 28 18 359 33 13	Ruland's Hill..... Mount Pleasant.....	112 33 58 179 33 14			13145.1 8338.6	14375.1 9118.9	8.17 5.18
Smithtown	40 54 17.75	73 14 28.92	329 14 08 286 05 31	Mount Pleasant..... Stony Brook.....	149 16 54 106 08 16			11686.1 6147.1	12779.6 6722.3	7.26 3.82
Ketchum.....	40 53 04.16	73 17 29.72	307 14 59 269 25 15	Mount Pleasant..... Blydenburgh	127 19 44 89 29 26			12832.6 9093.6	14033.4 9944.5	7.97 5.65
Carl.....	40 48 54.49	73 17 55.30	231 12 13 184 27 16	Blydenburgh..... Ketchum.....	51 16 35 4 27 27			12436.7 7723.2	13600.4 8445.9	7.73 4.80
Crane Neck	40 57 52.88	73 08 57.39	12 31 48 49 28 46	Stony Brook..... Smithtown	192 30 56 229 25 09			8544.5 10205.8	9344.0 11160.2	5.31 6.34
Broken Land	40 55 24.02	73 17 52.03	289 20 24 249 47 19	Stony Brook..... Crane Neck.....	109 25 26 69 53 13			11299.1 13320.1	12355.4 14566.5	7.02 8.28

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Nassekeag	40 54 31.68	73 05 21.28	323 53 09 33 12 43	Ruland's Hill	143 55 35	8873.5	9703.8	5.52
				Mount Pleasant	213 09 31	12515.4	13686.5	7.78
Cumsewang	40 56 06.81	73 03 28.19	35 20 50 345 40 12	Mount Pleasant	215 16 25	16430.3	17967.7	10 21
				Ruland's Hill	165 41 24	10427.8	11403.5	6 48
Mooney Ponds	40 49 55.45	73 04 58.58	253 57 11 176 26 01	Ruland's Hill	73 59 22	4889.0	5346.8	3.04
				Nassekeag	356 25 46	8536.8	9335.6	8.10
Mount Misery	40 57 41.23	73 03 38.68	155 03 14 267 53 32	Tashua Hill	334 55 59	36560.8	39981.8	22.72
				Friar's Head	88 06 51	28487.6	31153.2	17.70
Miller's Place	40 57 55.81	72 59 33.40	147 08 23 85 31 17	Tashua Hill	326 58 26	38944.8	42588.9	24.20
				Mount Misery	265 28 36	5754.2	6292.6	3.58
Old Field Point	40 58 33.66	73 06 47.60	67 29 40 344 51 26	Crane Neck	247 28 15	3284.8	3592.2	2.04
				Nassekeag	164 52 34	7731.3	8454.7	4.80
Andrew Miller	40 57 35.74	73 05 43.76	140 07 42 96 40 38	Old Field	320 07 00	2328.9	2546.8	1.45
				Crane Neck	276 38 31	4558.3	4984.8	2.83
Setauket Episcopal church, (spire.)	40 56 45.48	73 06 25.63	120 22 25 212 16 51	Crane Neck	300 20 46	4112.7	4497.5	2.56
				Andrew Miller	32 17 19	1833.5	2005.1	1.14
Setauket Presbyterian church, (spire.)	40 56 43.04	73 06 20.85	120 29 13 208 05 16	Crane Neck	300 27 30	4247.3	2644.7	2.64
				Andrew Miller	28 05 40	1842.3	2014.7	1.14
Old Field Point Light-house .	40 58 34.45	73 06 47.83	320 24 18 67 03 14	Andrew Miller	140 25 00	2351.0	2571.0	1.46
				Crane Neck	247 01 49	3289.5	3597.3	2.04
Stony Brook Bank	40 55 17.25	73 08 32.64	34 29 30 90 57 45	Stony Brook	214 28 20	4296.5	4698.5	2.67
				Broken Land	270 51 33	13089.6	14314.4	8.13

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.		
					° ' "	Metres.	Yards.	Metres.	Yards.	Miles.
Nissequague	40 55 04.58	73 10 37.85	351 02 10 262 23 21	Stony Brook	171 02 19	3189.8	3488.3	3189.8	3488.3	1.98
				Stony Brook Bank	82 24 40	2954.8	3231.3	2954.8	3231.3	1.84
East Blydenburgh	40 51 14.52	73 12 19.62	207 52 22 326 07 52	Blydenburgh	27 53 10	3923.1	4290.2	3923.1	4290.2	2.44
				Mount Pleasant	146 09 14	5290.1	5785.1	5290.1	5785.1	3.29
Buffet	40 53 17.48	73 16 39.37	272 19 05 312 09 25	Blydenburgh	92 22 43	7920.8	8662.0	7920.8	8662.0	4.92
				Mount Pleasant	132 13 37	12187.7	14128.1	12187.7	14128.1	7.57
Dix Hill	40 48 57.07	73 20 39.32	88 47 16 330 58 57	West Hills	268 44 18	6396.8	6995.4	6396.8	6995.4	3.97
				Base West	151 04 12	23619.2	25829.2	23619.2	25829.2	14.68
Huntington	40 51 07.16	73 25 04.71	2 25 32 302 48 36	West Hills	182 25 27	4153.9	4542.6	4153.9	4542.6	2.58
				Dix Hill	122 51 31	7399.4	8091.8	7399.4	8091.8	4.60
Long Hill	40 52 55.84	73 20 05.63	6 06 43 64 26 52	Dix Hill	186 06 22	7405.9	8098.9	7405.9	8098.9	4.60
				Huntington	244 23 37	7763.0	8489.4	7763.0	8489.4	4.82
Eaton	40 56 18.77	73 23 13.07	324 57 58 15 13 00	Long Hill	145 00 01	7643.0	8358.2	7643.0	8358.2	4.75
				Huntington	195 11 47	9960.0	10892.0	9960.0	10892.0	6.19
Sheep	40 51 00.91	73 30 17.89	153 57 37 61 58 45	Round Hill	333 51 11	31245.7	34169.4	31245.7	34169.4	19.41
				Harrow	241 53 41	12327.6	13481.1	12327.6	13481.1	7.66
Mill Neck	40 52 57.59	73 33 06.20	36 26 37 312 23 09	Harrow	216 23 23	11678.7	12771.5	11678.7	12771.5	7.26
				Sheep	132 24 59	5336.8	5836.2	5336.8	5836.2	3.32
Cooper's Bluff	40 53 37.05	73 29 31.04	76 25 55 12 50 14	Mill Neck	256 23 35	5181.3	5666.1	5181.3	5666.1	3.22
				Sheep	192 49 38	4939.3	5401.7	4939.3	5401.7	3.07
East Fort	40 55 43.46	73 25 29.96	251 12 22 304 14 06	Eaton	71 13 51	3381.8	3698.2	3381.8	3698.2	2.10
				Long Hill	124 17 52	9183.0	10042.3	9183.0	10042.3	5.71

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Little Neck Point.....	40 54 46.17	73 22 11.09	153 05 21 110 48 54	Eaton East Fort.....	333 04 40 290 46 44	3202.7 4976.5	3502.4 5442.2	1.99 3.09
Crab Meadow	40 55 27.72	73 20 36.11	113 13 31 60 02 06	Eaton Little Neck Point.....	293 11 48 240 01 04	3994.5 2364.9	4368.3 2586.2	2.48 1.47
East Neck	40 54 15.81	73 25 25.56	219 14 51 258 21 34	Eaton Little Neck Point.....	39 16 18 78 23 42	4896.8 4644.9	5355.0 5079.5	3.04 2.89
Gallows Hill.....	40 52 58.41	73 23 29.42	69 17 01 183 32 17	Sheep Eaton	249 12 38 3 32 28	10227.9 6191.8	11184.9 6771.2	6.35 3.85
Huntington Harbor.....	40 53 36.72	73 24 43.10	202 50 38 304 24 34	Eaton Gallows Hill.....	22 51 37 124 25 32	5423.6 2091.1	5931.1 2286.8	3.37 1.30
Van Wyck	40 53 33.90	73 26 13.59	219 41 57 285 53 38	Eaton Gallows Hill.....	39 43 46 105 55 25	6609.9 3990.9	7228.4 4364.3	4.11 2.48
Crossman	40 54 22.76	73 28 21.16	243 34 16 290 49 53	Eaton Gallows Hill	63 37 38 110 53 04	8046.9 7307.2	8799.9 7990.9	5.00 4.54
Huntington Spire.....	40 52 25.42	73 24 52.24	185 32 38 242 18 13	Huntington Harbor..... Gallows Hill	5 32 43 62 19 07	2209.7 2189.5	2416.5 2394.3	1.37 1.36
Northport	40 54 19.10	73 20 43.30	45 58 18 136 30 05	Huntington..... Eaton	225 55 27 316 28 27	8514.8 5089.5	9311.5 5565.7	5.29 3.16
Centreport	40 53 10.54	73 21 55.18	162 34 37 218 30 09	Eaton North Point	342 33 46 38 30 56	6084.8 2702.1	6654.2 2954.9	3.78 1.68
Eaton's Point Light-house...	40 57 11.86	73 23 25.06	350 17 09 46 58 59	Eaton East Fort	170 17 17 226 57 38	1661.5 3995.8	1817.0 4369.7	1.03 2.48

United States Coast Survey.—Geographical Positions. Section II.—Long Island. Sketch B, No. 2.

Name of station	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Allen	40 53 59.86	73 32 39.48	328 59 53 279 02 50	Sheep	149 01 26	6438.4	7040.8	4.00
				Cooper's Bluff	99 04 53	4466.2	4884.1	2.78
Ludlum	40 54 56.23	73 31 09.93	350 28 02 284 37 57	Sheep	170 28 36	7360.0	8048.7	4.57
				Crossman	104 39 48	4082.1	4464.1	2.54
Oyster Bay	40 53 00.85	73 32 43.12	317 23 52 256 02 13	Sheep	137 25 27	5024.8	5495.0	3.12
				Cooper's Bluff	76 04 19	4632.6	5066.1	2.88
Northwest Bluff	40 55 34 83	73 29 23.48	2 47 15 44 32 46	Cooper's Bluff	182 47 10	3637.3	3977.6	2.26
				Oyster Bay	224 30 35	6662.0	7285.4	4.14
Lloyd's Neck	40 56 20.32	73 28 01.64	270 22 51 17 56 49	Eaton	90 26 00	6749.6	7381.2	4.19
				Sheep	197 55 20	10355.5	11324.5	6.43
Centre Island	40 53 14.45	73 31 10.72	343 16 45 253 21 41	Sheep	163 17 20	4300.7	4703.1	2.67
				Cooper's Bluff	73 22 46	2435.1	2662.9	1.51
Jones	40 51 36.55	73 28 16.81	68 49 05 154 56 48	Sheep	248 47 40	3041.4	3326.0	1.89
				Cooper's Bluff	334 55 59	4102.6	4486.5	2.55
Cold Spring	40 52 14.15	73 27 28.84	131 48 06 44 05 30	Cooper's Bluff	311 46 46	3836.8	4195.8	2.38
				Jones	224 04 59	1614.5	1765.6	1.00
Dekay	40 52 24.53	73 30 23.98	144 36 31 108 59 41	Centre Island	324 36 00	1889.3	2066.1	1.17
				Oyster Bay	288 58 10	3444.7	3767.0	2.14
Oyster Bay Academy	40 52 19.48	73 31 21.90	227 18 58 123 52 26	Cooper's Bluff	47 20 11	3529.7	3860.0	2.19
				Oyster Bay	303 51 33	2289.9	2504.2	1.42
Kirby	40 48 26.78	73 31 12.55	240 06 41 195 04 16	Huntington	60 10 42	9936.3	10866.0	6.17
				Sheep	15 04 52	4934.5	5396.2	3.07

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Townsend	40 53 01.43	73 36 17.24	271 30 35 14 29 28	Mill Neck..... Harrow.....	91 32 38 194 28 20	4473.8 9829.6	4892.4 10749.4	2.78 6.11
Wheatley	40 48 12.25	73 34 48.91	82 30 21 166 57 00	Harrow..... Townsend.....	262 28 15 346 56 09	4568.7 9156.9	4996.2 10013.7	2.84 5.69
Onderdonk	40 49 06.99	73 40 12.83	217 19 27 306 43 20	Townsend..... Harrow.....	37 22 00 126 44 45	9096.7 3821.3	9947.9 4178.9	5.65 2.37
LONG ISLAND SOUND.								
Western part.								
Sands' Point.....	40 51 59.62	73 42 48.35	258 12 15 325 36 41	Townsend..... Onderdonk.....	78 16 31 145 38 20	9353.7 6452.0	10228.9 7055.7	5.81 4.01
Matinicoek Point.....	40 54 07.29	73 37 39.76	316 26 28 61 25 57	Townsend..... Sands' Point.....	136 27 23 241 22 35	2803.2 8228.0	3065.5 8997.9	1.74 5.11
Oak Neck Point.....	40 54 53.29	73 33 39.79	46 55 16 291 59 10	Townsend..... Cooper's Bluff.....	226 53 33 112 01 53	5049.6 6276.2	5522.1 6863.5	3.14 3.90
Little Captain's Island.....	40 59 22.36	73 36 10.94	0 43 10 34 16 57	Townsend..... Sands' Point.....	180 43 06 214 12 37	11751.6 16521.5	12851.2 18067.4	7.30 10.26
Great Captain's Island Light-house.	40 58 54.55	73 37 06.39	118 19 52 236 33 23	Sawpits..... Captain's Island.....	298 17 57 56 34 38	4680.0 1554.0	5117.9 1699.4	2.91 0.97
Manursing Island Point.....	40 58 00.44	73 39 22.87	334 45 41 23 22 29	Townsend..... Sands' Point.....	154 48 09 203 20 41	10194.9 12124.1	11148.8 13258.5	6.33 7.53
Glen Cove.....	40 51 42.61	73 38 25.54	321 57 07 355 34 46	Wheatley..... Harrow.....	141 59 23 175 35 01	8237.4 7106.9	9008.2 7771.9	5.12 4.41

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Glen Cove Wharf	40 51 47.49	73 39 00.32	94 01 54 121 13 52	Sands' Point..... Premium Point	273 59 24 301 09 51	5352.6 10149.0	5853.4 11098.6	3.33 6.31
Buckram.....	40 51 58.34	73 34 32.47	32 59 56 84 56 50	Harrow..... Glen Cove.....	312 57 39 264 54 18	9024.7 5478.9	9869.1 5991.6	5.61 3.41
Coles.....	40 51 48.42	73 36 27.58	16 58 25 86 17 50	Harrow..... Glen Cove.....	196 57 23 266 16 34	7595.8 2768.4	8306.5 3027.4	4.72 1.72
Poplar Hill.....	40 52 55.06	73 37 52.00	264 56 00 1 27 13	Townsend..... Harrow.....	84 57 01 181 27 06	2229.0 9323.8	2437.6 10196.2	1.39 5.79
Underhill	40 52 36.14	73 35 36.98	21 16 48 307 39 12	Harrow..... Buckram.....	201 15 30 127 40 11	9375.1 1907.9	10252.3 2086.4	5.82 1.18
Carpenter	40 50 52.91	73 38 24.48	354 37 15 249 36 23	Harrow..... Buckram.....	174 37 30 69 38 57	5577.5 5795.7	6099.4 6338.0	3.47 3.60
Carpenter's Neck	40 50 55.03	73 38 51.10	145 06 16 112 59 32	Delancy..... Mott's Point.....	325 03 24 292 58 38	10738.7 2116.9	11743.5 2315.0	6.67 1.31
Downing	40 50 22.11	73 37 39.66	57 09 58 6 32 22	Onderdonk..... Harrow.....	237 08 07 186 32 07	4272.1 4633.1	4671.8 5066.6	2.65 2.88
Hegerman	40 49 45.00	73 39 18.75	243 44 56 332 34 32	Downing..... Harrow.....	63 45 27 152 34 47	2588.3 3896.0	2830.5 4260.5	1.61 2.42
Cheeseman.....	40 49 35.94	73 38 31.53	220 28 12 347 46 58	Downing..... Harrow.....	40 28 46 167 47 17	1872.2 3252.4	2047.4 3556.7	1.16 2.02
Peacock Point.....	40 54 05.84	73 36 24.00	91 27 07 355 26 50	Matinicoek Point..... Townsend.....	271 26 16 175 26 54	1773.6 1993.2	1939.6 2179.7	1.10 1.24

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Henry Mott	40 51 26.98	73 41 06.81	113 03 52 224 28 48	Sands' Point..... Matinick Point.....	293 02 46 44 31 03	2571.5 6933.1	2812.1 7581.8	1.60 4.31
Delancey	40 55 40.51	73 43 13.71	355 01 06 296 41 06	Sands' Point..... Townsend	175 01 22 116 45 38	6839.1 10912.1	7479.0 11933.1	4.25 6.78
Mamaroneck	40 56 49.96	73 43 47.37	303 45 09 351 13 34	Townsend	123 50 04	12674.3	13860.2	7.88
Scotch Caps, (2).....	40 56 06.91	73 41 42.24	11 28 16 306 55 24	Sands' Point..... Townsend	171 14 13 191 27 33 126 58 57	9061.8 7783.3 9517.5	9909.7 8511.6 10408.1	5.63 4.84 5.91
Premium Point	40 54 37.93	73 45 11.16	355 24 46 325 35 16	Hurtleberry Island..... Sands' Point.....	175 24 52 145 36 46	2531.2 5917.5	2768.1 6471.2	1.57 3.68
Rye Point.....	40 56 36.40	73 40 45.27	18 39 53 63 38 42	Sands' Point..... Delancey.....	198 38 32 243 37 04	9007.7 3876.5	9850.5 4239.2	5.60 2.41
Davenport's Neck.....	40 53 22.08	73 46 25.82	310 40 18 272 30 16	Harrow	130 45 47	15566.1	17022.6	9.67
Hurtleberry Island.....	40 53 16.13	73 45 02.52	272 03 52	Townsend	92 36 53	14261.1	15595.5	8.86
Red Spring.....	40 52 37.49	73 38 56.42	315 19 13 272 03 52	Harrow	135 23 49	14013.4	15324.6	8.71
Mott's Point	40 51 21.82	73 40 14.32	77 53 00 133 10 33	Townsend	92 09 36	12305.2	13456.6	7.64
Hart Island	40 50 40.67	73 45 46.86	77 53 00 133 10 33	Sands' Point..... Delancey.....	257 50 28 313 07 44	5554.8 8254.2	6074.6 9026.5	3.45 5.13
			152 15 28 217 59 52	Delancey	332 13 30	9017.0	9860.7	5.60
			239 45 49 290 14 13	Red Spring.....	38 00 54	2962.4	3239.6	1.84
				Sands' Point..... Onderdonk	59 47 46 110 17 55	4838.4 8342.4	5291.1 9123.0	3.01 5.18

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Sands' Point Light-house.....	40 51 54.63	73 43 27.56	55 02 58 138 31 15	Hart Island Hurtleberry Island	235 01 36 318 30 13	3980.2 3355.9	4352.6 3669.9	2.47 2.08
Barker's Point.....	40 50 50.93	73 43 50.76	159 26 28 83 23 30	Hurtleberry Island Hart Island	339 25 41 263 21 58	4783.9 2738.0	5231.5 2994.2	2.97 1.70
Kissam.....	40 46 53.16	73 42 31.06	253 41 02 218 06 20	Harrow Onderdonk	73 43 50 38 07 50	6565.9 5246.4	7180.3 5737.3	4.08 3.26
High Island.....	40 51 31.38	73 46 47.04	217 07 49 295 42 41	Hurtleberry Island Onderdonk	37 08 57 115 47 00	4053.5 10253.1	4432.8 11212.5	2.52 6.37
Beaconhill.....	40 49 57.93	73 40 19.65	354 10 39 107 39 25	Onderdonk High Island	174 10 40 287 34 59	1580.5 9520.1	1728.4 10410.9	0.98 5.92
S. S. Smith.....	40 48 34.27	73 44 01.06	243 31 47 144 33 52	Beacon Hill..... High Island	63 34 22 324 32 01	5793.6 6705.2	6335.7 7332.6	3.60 4.17
J. W. Mott.....	40 48 57.07	73 42 55.61	242 47 21 159 48 31	Beacon Hill Barker's Point.....	62 48 55 339 47 58	4107.9 3741.8	4492.3 4091.9	2.55 2.32
Cornwell.....	40 50 28.08	73 43 05.09	283 28 21 20 29 15	Beacon Hill S. S. Smith	103 30 09 200 28 27	3985.1 3746.6	4358.0 4097.2	2.48 2.33
Hicks.....	40 48 28.06	73 42 48.73	251 47 31 174 05 14	Onderdonk Cornwell	71 49 13 354 05 12	3845.7 3721.8	4205.5 4070.1	2.39 2.31
Mitchell's Bluff.....	40 49 28.50	73 41 56.74	248 13 25 112 27 43	Beacon Hill Hart Island.....	68 14 29 292 25 13	2449.5 5833.0	2678.7 6378.8	1.52 3.63
Mitchell, (2).....	40 49 28.46	73 41 56.84	248 13 17 138 59 49	Beacon Hill Cornwell	68 14 21 318 59 04	2451.6 2436.6	2681.0 2664.6	1.52 1.51

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Great Neck	40 48 50.26	73 45 19.78	253 26 23 157 38 49	Beacon Hill..... High Island.....	73 29 42 337 37 42	7335.1 5373.3	8021.4 5876.1	4.56 3.34
Hammond.....	40 48 37.52	73 48 06.01	199 01 24 264 13 14	High Island..... Great Neck.....	19 02 10 84 15 07	5672.5 3915.1	6203.3 4281.4	3.53 2.43
Wilkins' Point.....	40 47 42.50	73 46 28.62	190 05 31 126 38 23	Hart Island..... Hammond.....	10 05 58 306 37 19	5582.4 2844.2	6104.8 3110.3	3.47 1.77
City Island.....	40 50 19.57	73 46 43.20	310 29 09 256 32 00	S. S. Smith..... Barker's Point.....	130 30 53 76 34 06	5000.5 4156.3	5468.4 4545.2	3.11 2.58
Rodman's Neck.....	40 51 18.96	73 47 46.92	290 54 00 259 47 58	Onderdonk..... Sands' Point.....	110 58 57 79 51 13	11389.3 7103.1	12455.0 7767.7	7.08 4.41
Bownes.....	40 45 24.93	73 44 56.92	231 29 05 159 58 10	Kissam..... Rodman's Neck.....	51 30 40 339 56 19	4371.5 11624.1	4780.5 12711.8	2.72 7.22
Hewlett's Point.....	40 50 01.71	73 44 49.63	222 15 32 131 52 37	Barker's Point..... Hart Island.....	42 16 27 311 52 00	2050.6 1800.5	2242.5 1969.0	1.27 1.13
Little Bay Side.....	40 45 56.19	73 44 18.56	153 53 30 235 06 42	Rodman's Neck..... Kissam.....	333 51 14 55 07 50	11089.0 3073.4	12126.6 3361.0	6.89 1.91
White Stone Point.....	40 47 58.52	73 48 55.48	223 56 39 278 09 20	Hammond..... Wilkins' Point.....	43 56 55 98 10 39	1670.8 3477.3	1827.1 3802.7	1.04 2.16
Old Ferry Point.....	40 48 21.36	73 49 47.17	258 07 03 300 10 30	Hammond..... White Stone Point.....	78 08 09 120 11 20	2422.7 1401.5	2649.4 1532.6	1.51 0.87
Ferris.....	40 50 20.82	73 48 36.60	229 41 25 301 10 55	High Island..... Great Neck.....	49 42 37 121 13 03	3364.9 5391.5	3679.7 5896.0	2.09 3.35

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Old Hen.....	40 52 20.46	73 42 28.59	35 44 49 115 29 14	Sands' Point..... Hurtleberry Island.....	215 44 36 295 27 55	791.8 3992.0	865.9 4365.5	0.49 2.48
Execution Rocks.....	40 52 42.24	73 43 55.97	309 41 52 34 42 48	Sands' Point..... Hart Island.....	129 42 36 214 41 35	2057.9 4565.0	2250.5 4992.1	1.28 2.84
Execution Buoy.....	40 52 41.93	73 43 48.58	312 46 17 36 31 59	Sands' Point..... Hart Island.....	132 46 56 216 30 41	1921.4 4660.0	2101.2 5096.0	1.19 2.90
College Point.....	40 47 35.88	73 50 52.12	255 39 43 227 19 40	White Stone Point..... Old Ferry Point.....	75 41 15 47 20 22	2821.4 2069.8	3085.4 2263.5	1.75 1.29
Success.....	40 45 36.43	73 42 06.23	202 14 59 244 50 38	Onderdonk..... Wheatley.....	22 16 13 64 55 18	7017.4 11323.1	7674.0 12382.6	4.36 7.03
CONNECTICUT.								
Loafhill.....	41 19 32.29	73 29 35.02	289 16 41 352 12 18	Tashua Hill..... Bald Hill.....	109 26 31 172 13 06	22041.4 12605.9	24103.8 13785.4	13.70 7.83
Goodsall.....	41 15 56.06	73 24 35.42	42 09 50 133 46 08	Bald Hill..... Loafhill.....	222 07 21 313 42 49	7849.0 9646.8	8583.4 10549.5	4.88 5.99
Centre Reading.....	41 18 58.20	73 22 37.79	35 00 33 96 13 27	Bald Hill..... Loafhill.....	214 56 46 276 08 49	13959.5 9759.1	15265.7 10672.3	8.67 6.06
High Ridge.....	41 16 21.75	73 29 49.00	276 10 02 342 53 17	Goodsall..... Bald Hill.....	96 13 27 162 54 14	7340.9 6918.0	8027.8 7565.3	4.56 4.30
Wheeler's Hill.....	41 15 11.05	73 19 21.26	146 53.16 263 23.56	Centre Reading..... Tashua Hill.....	326 51 08 83 27 01	8367.0 6563.1	9149.9 7177.2	5.20 4.08

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Goodridge	41 19 39.48	73 18 29.05	77 36 31 324 49 31	Centre Reading	257 33 48	5922.8	6477.0	3.68
				Tashua Hill	144 52 01	9208.0	10069.6	5.72
Barnhill	41 20 38.02	73 10 46.59	80 30 34 30 19 50	Goodridge	260 25 29	10902.5	11922.6	6.77
				Tashua Hill	210 17 15	10812.0	11823.7	6.72
Pine-swamp Hill	41 21 06.70	73 16 09.05	276 42 12 348 40 45	Barnhill	96 45 45	7547.7	8253.9	4.69
				Tashua Hill	168 41 43	10421.5	11396.6	6.47
Riggs' Hill	41 24 41.76	73 07 28.53	61 18 00 30 52 13	Pine-swamp Hill	241 12 17	13793.7	15084.4	8.57
				Tashua Hill	210 47 27	19626.7	21463.2	12.20
Great Hill East	41 21 51.26	73 06 41.17	68 24 55 168 11 13	Barnhill	248 22 13	6135.3	6709.4	3.81
				Riggs' Hill	348 10 39	5373.1	5875.9	3.34
Hooper's Hill	41 24 54.06	72 59 43.64	59 51 59 88 01 46	Great Hill East	239 47 21	11219.1	12268.9	6.97
				Riggs' Hill	267 56 38	10802.2	11813.0	6.71
Peck's Hill	41 22 51.68	73 03 10.21	119 31 46 231 47 08	Riggs' Hill	299 28 55	6894.4	7539.5	4.28
				Hooper's Hill	51 49 25	6105.1	6676.4	3.79
Chestnut-tree Hill	41 26 24.16	73 05 22.24	42 52 47 334 55 05	Riggs' Hill	222 51 23	4309.9	4713.2	2.68
				Peck's Hill	154 56 32	7236.1	7913.2	4.50
Hicock, (2)	41 23 10.32	72 59 53.42	184 03 36 82 50 56	Hooper's Hill	4 03 48	3208.2	3508.4	1.99
				Peck's Hill	262 48 51	4607.7	5038.8	2.86
West Rock Ridge	41 25 05.35	72 56 58.45	84 49 46 48 53 33	Hooper's Hill	264 47 53	3851.7	4212.1	2.39
				Hicock, (2)	228 51 37	5395.0	5899.8	3.35
Collins' Hill	41 26 17.91	73 00 24.58	295 02 50 339 49 15	West Rock Ridge	115 05 02	5283.2	5777.5	3.28
				Hooper's Hill	159 49 34	2755.4	3013.2	1.71

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

S. Doc. 3.

265

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Huddenston's Hill.....	41 26 54.73	72 58 04.51	335 34 23 70 47 58	West Rock Ridge..... Collins' Hill.....	155 35 07 250 46 30	3703.4 3445.6	4049.9 3768.0	2.30 2.14
Sandford, (near Mt. Carmel).	41 28 05.31	72 56 53.50	37 07 24 308 20 08	Huddenston's Hill..... Mount Carmel.....	217 06 37 128 22 39	2730.6 6753.1	2986.1 7385.0	1.70 4.20
Mount Ephraim.....	41 27 45.12	72 54 36.34	329 21 55 101 05 12	Mount Carmel..... Sandford.....	149 22 55 281 03 41	4146.1 3243.1	4534.0 3546.6	2.58 2.02
Cheshire Spire.....	41 29 50.45	72 53 51.87	52 25 43 351 43 52	Sandford..... Mount Carmel.....	232 23 43 171 44 23	5317.0 7511.9	5814.5 8214.8	3.30 4.67
Wallingford Spire.....	41 27 13.42	72 48 48.11	98 08 01 66 34 29	Sandford..... Mount Carmel.....	278 02 40 246 31 39	11376.7 6508.2	12441.2 7117.2	7.07 4.04
Dickerman.....	41 25 04.59	72 55 22.05	192 05 19 246 25 38	Mount Ephraim..... Mount Carmel.....	12 05 50 66 27 09	5064.2 3462.7	5538.0 3786.7	3.15 2.15
No Name.....	41 26 39.02	72 57 10 33	240 16 41 285 01 25	Mount Ephraim..... Mount Carmel.....	60 18 23 105 04 07	4114.4 5888.9	4499.4 6439.9	2.56 3.66
Lebanon.....	41 26 24.19	72 59 18.61	306 45 34 7 42 10	West Rock Ridge..... Hicock, (2).....	126 47 07 187 41 47	4062.4 6034.5	4442.5 6599.1	2.52 3.75
Slate Hill.....	41 22 25.78	72 58 31.84	203 46 34 125 56 53	West Rock Ridge..... Hicock, (2).....	23 47 36 305 55 59	5379.2 2341.1	5882.5 2560.2	3.34 1.45
Mount Prospect.....	41 28 20.31	72 57 55.97	15 55 38 70 57 29	Hicock, (2)..... Chestnut-tree Hill.....	195 54 20 250 52 38	9943.2 10958.3	10873.6 11983.7	6.18 6.81
Summerville.....	41 20 30.34	73 03 08.29	222 31 25 164 06 04	Hicock, (2)..... Chestnut-tree Hill.....	42 33 34 344 04 40	6698.0 11349.1	7324.7 12411.0	4.16 7.05

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude. O ' "	Longitude. O ' "	Azimuth. O ' "	To station—	Back azimuth. O ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Skagerat.....	41 24 48.32	73 02 48.56	89 27 56 45 27 14	Riggs' Hill Great Hill East.....	269 24 51 225 24 43	6502.1 7585.0	7110.5 8294.7	4.04 4.71
Newtown.....	41 25 49.47	73 01 44.41	75 22 59 43 11 55	Riggs' Hill Great Hill East.....	255 19 11 223 08 40	8258.3 10074.2	9031.0 11016.8	5.13 6.26
Moose Hill East.....	41 24 03.18	73 06 35.21	294 49 59 201 15 34	Peck's Hill..... Chestnut-tree Hill.....	114 52 19 21 16 27	5246.6 4667.1	5737.5 5103.8	3.26 2.90
Rock-house Hill.....	41 23 02.54	73 08 01.93	194 10 00 319 27 13	Riggs' Hill..... Great Hill East.....	14 13 42 139 31 25	3157.4 2890.7	3452.8 3161.2	1.96 1.80
Blackburn Hill.....	41 21 32.95	73 11 22.98	223 03 32 83 05 03	Riggs' Hill Pine-swamp Hill	43 06 06 263 01 54	7974.0 6698.0	8720.1 7324.7	4.95 4.16
White Hill Church.....	41 20 00.35	73 08 32.13	100 57 12 46 26 40	Pine-swamp Hill Tashua Hill	280 51 33 226 22 36	10815.6 11852.5	11827.6 12961.5	6.72 7.36
Moose Hill	41 19 09.32	73 11 45.91	95 42 19 31 43 52	Goodridge..... Tashua Hill	275 37 53 211 41 56	9420.7 7756.3	10302.2 8482.1	5.85 4.82
South Whitehill.....	41 19 10.51	73 07 36.01	89 39 42 56 11 15	Moose Hill..... Tashua Hill.....	269 36 56 236 06 34	5811.6 11910.6	6355.4 13025.1	3.61 7.40
Booth	41 16 40.03	73 10 46.07	223 35 18 70 00 33	South Whitehill..... Tashua Hill	43 37 24 249 57 58	6410.7 5822.9	7010.6 6367.8	3.98 3.62
Hawley	41 19 15.06	73 14 35.33	97 54 46 1 08 48	Goodridge..... Tashua Hill	277 52 12 181 08 44	5486.7 6776.6	6000.1 7410.7	3.41 4.21
Monroe Tall Spire.....	41 19 56.41	73 12 06.74	86 40 22 24 03 42	Goodridge..... Tashua Hill	266 36 09 204 02 00	8904.7 8816.0	9737.9 9640.9	5.43 5.48

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance. Metres.	Distance. Yards.	Distance. Miles.
					°	'	"			
Trumbull	41 17 44.51	73 15 24.36	49 22 11 345 49 44	Wheeler's Hill..... Tashua Hill	229	19	35	7266.4 4107.2	7946.3 4491.5	4.51 2.55
Tashua Church	41 17 10.88	73 15 18.71	56 48 19 343 27 58	Wheeler's Hill..... Tashua Hill	236	45	39	6747.2 3071.6	7378.5 3359.0	4.19 1.91
Weston Spire.....	41 14 59.19	73 17 50.42	117 15 49 74 35 48	Loafhill..... Bald Hill.....	297	08	02	18430.7 15249.5	20155.3 16676.4	11.45 9.47
Dead-tree Hill.....	41 17 10.75	73 18 39.36	14 47 50 297 55 24	Wheeler's Hill..... Tashua Hill	194	47	22	3818.7 6275.0	4176.0 6862.1	2.37 3.90
Reading Ridge.....	41 18 08.66	73 20 52.17	102 01 27 46 35 25	Loafhill..... Bald Hill.....	281	55	39	12429.8 14410.3	13592.9 15758.7	7.72 8.95
Ridgefield, (Presbyterian ch.)	41 16 28.03	73 29 32.83	278 04 55 346 18 08	Goodsall..... Bald Hill.....	98	08	10	6991.4 7005.0	7645.6 7660.5	4.34 4.35
Reading Spire.....	41 18 47.27	73 20 44.22	96 28 08 43 50 35	Loafhill..... Bald Hill.....	276	22	21	12421.5 15380.2	13583.8 16819.3	7.72 9.56
Picket's Ridge.....	41 19 27.03	73 26 51.37	92 28 17 35 53 46	Loafhill..... High Ridge.....	272	26	29	3808.8 7051.1	4165.2 7710.9	2.37 4.38
Baker's Hill.....	41 18 26.89	73 31 00.24	224 28 50 336 45 08	Loafhill..... High Ridge.....	44	29	46	2828.3 4199.4	3093.0 4592.3	1.76 2.61
Patrick.....	41 17 33.80	73 30 58.56	288 38 49 323 55 26	Goodsall..... High Ridge.....	108	43	04	9410.0 2749.2	10290.5 3006.4	5.85 1.71
Hanford	41 14 59.84	73 30 57.30	318 23 57 212 10 23	Bald Hill..... High Ridge.....	138	25	40	5462.2 2985.1	5973.3 3264.4	3.39 1.85

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Goodridge	41 19 39.48	73 18 29.05	77 36 31 324 49 31	Centre Reading	257 33 48	5922.8	6477.0	3.68
				Tashua Hill	144 52 01	9208.0	10069.6	5.72
Barnhill	41 20 38.02	73 10 46.59	80 30 34 30 19 50	Goodridge	260 25 29	10902.5	11922.6	6.77
				Tashua Hill	210 17 15	10812.0	11823.7	6.72
Pine-swamp Hill	41 21 06.70	73 16 09.05	276 42 12 348 40 45	Barnhill	96 45 45	7547.7	8253.9	4.69
				Tashua Hill	168 41 43	10421.5	11396.6	6.47
Riggs' Hill	41 24 41.76	73 07 28.53	61 18 00 30 52 13	Pine-swamp Hill	241 12 17	13793.7	15084.4	8.57
				Tashua Hill	210 47 27	19626.7	21463.2	12.20
Great Hill East	41 21 51.26	73 06 41.17	68 24 55 168 11 13	Barnhill	248 22 13	6135.3	6709.4	3.81
				Riggs' Hill	348 10 39	5373.1	5875.9	3.34
Hooper's Hill	41 24 54.06	72 59 43.64	59 51 59 88 01 46	Great Hill East	239 47 21	11219.1	12268.9	6.97
				Riggs' Hill	267 56 38	10802.2	11813.0	6.71
Peck's Hill	41 22 51.68	73 03 10.21	119 31 46 231 47 08	Riggs' Hill	299 28 55	6894.4	7539.5	4.28
				Hooper's Hill	51 49 25	6105.1	6676.4	3.79
Chestnut-tree Hill	41 26 24.16	73 05 22.24	42 52 47 334 55 05	Riggs' Hill	222 51 23	4309.9	4713.2	2.68
				Peck's Hill	154 56 32	7236.1	7913.2	4.50
Hicock, (2)	41 23 10.32	72 59 53.42	184 03 36 82 50 56	Hooper's Hill	4 03 48	3208.2	3508.4	1.99
				Peck's Hill	262 48 51	4607.7	5038.8	2.86
West Rock Ridge	41 25 05.35	72 56 58.45	84 49 46 48 53 33	Hooper's Hill	264 47 53	3851.7	4212.1	2.39
				Hicock, (2)	228 51 37	5395.0	5899.8	3.35
Collins' Hill	41 26 17.91	73 00 24.58	295 02 50 339 49 15	West Rock Ridge	115 05 02	5283.2	5777.5	3.28
				Hooper's Hill	159 49 34	2755.4	3013.2	1.71

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
						Metres.	Yards.	Miles.
Huddenston's Hill.....	41 26 54.73	72 58 04.51	335 34 23 70 47 58	West Rock Ridge..... Collins' Hill.....	155 35 07 250 46 30	3703.4 3445.6	4049.9 3768.0	2.30 2.14
Sandford, (near Mt. Carmel).	41 28 05.31	72 56 53.50	37 07 24 308 20 08	Huddenston's Hill..... Mount Carmel.....	217 06 37 128 22 39	2730.6 6753.1	2986.1 7385.0	1.70 4.20
Mount Ephraim.....	41 27 45.12	72 54 36.34	329 21 55 101 05 12	Mount Carmel..... Sandford.....	149 22 55 281 03 41	4146.1 3243.1	4534.0 3546.6	2.58 2.02
Cheshire Spire.....	41 29 50.45	72 53 51.87	52 25 43 351 43 52	Sandford..... Mount Carmel.....	232 23 43 171 44 23	5317.0 7511.9	5814.5 8214.8	3.30 4.67
Wallingford Spire.....	41 27 13.42	72 48 48.11	98 08 01 66 34 29	Sandford..... Mount Carmel.....	278 02 40 246 31 39	11376.7 6508.2	12441.2 7117.2	7.07 4.04
Dickerman.....	41 25 04.59	72 55 22.05	192 05 19 246 25 38	Mount Ephraim..... Mount Carmel.....	12 05 50 66 27 09	5064.2 3462.7	5538.0 3786.7	3.15 2.15
No Name.....	41 26 39.02	72 57 10 33	240 16 41 285 01 25	Mount Ephraim..... Mount Carmel.....	60 18 23 105 04 07	4114.4 5888.9	4499.4 6439.9	2.56 3.66
Lebanon.....	41 26 24.19	72 59 18.61	306 45 34 7 42 10	West Rock Ridge..... Hicock, (2).....	126 47 07 187 41 47	4062.4 6034.5	4442.5 6599.1	2.52 3.75
Slate Hill.....	41 22 25.78	72 58 31.84	203 46 34 125 56 53	West Rock Ridge..... Hicock, (2).....	23 47 36 305 55 59	5379.2 2341.1	5882.5 2560.2	3.34 1.45
Mount Prospect.....	41 28 20.31	72 57 55.97	15 55 38 70 57 29	Hicock, (2)..... Chestnut-tree Hill.....	195 54 20 250 52 38	9943.2 10958.3	10873.6 11983.7	6.18 6.81
Summerville.....	41 20 30.34	73 03 08.29	222 31 25 164 06 04	Hicock, (2)..... Chestnut-tree Hill.....	42 33 34 344 04 40	6698.0 11349.1	7324.7 12411.0	4.16 7.05

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Skagerat.....	41 24 48.32	73 02 48.56	89 27 56 45 27 14	Riggs' Hill	269 24 51	6502.1	7110.5	4.04
				Great Hill East.....	225 24 43	7585.0	8294.7	4.71
Newtown.....	41 25 49.47	73 01 44.41	75 22 59 43 11 55	Riggs' Hill	255 19 11	8258.3	9031.0	5.13
				Great Hill East.....	223 08 40	10074.2	11016.8	6.26
Moose Hill East.....	41 24 03.18	73 06 35.21	294 49 59 201 15 34	Peck's Hill.....	114 52 19	5246.6	5737.5	3.26
				Chestnut-tree Hill.....	21 16 27	4667.1	5103.8	2.90
Rock-house Hill.....	41 23 02.54	73 08 01.93	194 10 00 319 27 13	Riggs' Hill.....	14 13 42	3157.4	3452.8	1.96
				Great Hill East.....	139 31 25	2890.7	3161.2	1.80
Blackburn Hill.....	41 21 32.95	73 11 22.98	223 03 32 83 05 03	Riggs' Hill	43 06 06	7974.0	8720.1	4.95
				Pine-swamp Hill	263 01 54	6698.0	7324.7	4.16
White Hill Church.....	41 20 00.35	73 08 32.13	100 57 12 46 26 40	Pine-swamp Hill	280 51 33	10815.6	11827.6	6.72
				Tashua Hill	226 22 36	11852.5	12961.5	7.36
Moose Hill	41 19 09.32	73 11 45.91	95 42 19 31 43 52	Goodridge.....	275 37 53	9420.7	10302.2	5.85
				Tashua Hill	211 41 56	7756.3	8482.1	4.82
South Whitehill.....	41 19 10.51	73 07 36.01	89 39 42 56 11 15	Moose Hill.....	269 36 56	5811.6	6355.4	3.61
				Tashua Hill.....	236 06 34	11910.6	13025.1	7.40
Booth	41 16 40.03	73 10 46.07	223 35 18 70 00 33	South Whitehill.....	43 37 24	6410.7	7010.6	3.98
				Tashua Hill	249 57 58	5822.9	6367.8	3.62
Hawley	41 19 15.06	73 14 35.33	97 54 46 1 08 48	Goodridge.....	277 52 12	5486.7	6000.1	3.41
				Tashua Hill	181 08 44	6776.6	7410.7	4.21
Monroe Tall Spire.....	41 19 56.41	73 12 06.74	86 40 22 24 03 42	Goodridge.....	266 36 09	8904.7	9737.9	5.43
				Tashua Hill	204 02 00	8816.0	9640.9	5.48

United States Coast Survey.—Geographical Positions. Section II.—Connecticut. Sketch B, No. 2.

Name of station.	Latitude.		Longitude.		Azimuth	To station—	Back azimuth.	Distance.	Distance.	Distance.
	°	' "	°	' "				Metres.	Yards.	Miles.
Trumbull	41	17 44.51	73	15 24.36	49 22 11 345 49 44	Wheeler's Hill Tashua Hill	229 19 35 165 50 13	7266.4 4107.2	7946.3 4491.5	4.51 2.55
Tashua Church	41	17 10.88	73	15 18.71	56 48 19 343 27 58	Wheeler's Hill Tashua Hill	236 45 39 163 28 23	6747.2 3071.6	7378.5 3359.0	4.19 1.91
Weston Spire	41	14 59.19	73	17 50.42	117 15 49 74 35 48	Loafhill Bald Hill	297 08 02 254 28 52	18430.7 15249.5	20155.3 16676.4	11.45 9.47
Dead-tree Hill	41	17 10.75	73	18 39.36	14 47 50 297 55 24	Wheeler's Hill Tashua Hill	194 47 22 117 58 01	3818.7 6275.0	4176.0 6862.1	2.37 3.90
Reading Ridge	41	18 08.66	73	20 52.17	102 01 27 46 35 25	Loafhill Bald Hill	281 55 39 226 30 28	12429.8 14410.3	13592.9 15758.7	7.72 8.95
Ridgefield, (Presbyterian ch.)	41	16 28.03	73	29 32.83	278 04 55 346 18 08	Goodsall Bald Hill	98 08 10 166 18 55	6991.4 7005.0	7645.6 7660.5	4.34 4.35
Reading Spire	41	18 47.27	73	20 44.22	96 28 08 43 50 35	Loafhill Bald Hill	276 22 21 223 45 35	12421.5 15380.2	13583.8 16819.3	7.72 9.56
Picket's Ridge	41	19 27.03	73	26 51.37	92 28 17 35 53 46	Loafhill High Ridge	272 26 29 215 51 46	3808.8 7051.1	4165.2 7710.9	2.37 4.38
Baker's Hill	41	18 26.89	73	31 00.24	224 28 50 336 45 08	Loafhill High Ridge	44 29 46 156 45 52	2828.3 4199.4	3093.0 4592.3	1.76 2.61
Patrick	41	17 33.80	73	30 58.56	288 38 49 323 55 26	Goodsall High Ridge	108 43 04 143 56 16	9410.0 2749.2	10290.5 3006.4	5.85 1.71
Hanford	41	14 59.84	73	30 57.30	318 23 57 212 10 23	Bald Hill High Ridge	138 25 40 32 11 09	5462.2 2985.1	5973.3 3264.4	3.39 1.85

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Hayes' Ridge.....	41 13 43.75	73 30 55.73	295 49 33 179 06 23	Bald Hill..... Hanford	115 51 15 359 06 22	3988.2 2445.6	4351.4 2674.4	2.48 1.52
Wills.....	41 12 12.86	73 30 23.91	249 28 59 165 11 36	Bald Hill..... Hayes' Ridge	69 30 20 345 11 15	3041.5 2900.1	3326.1 3171.5	1.89 1.80
Cravenbush.....	41 10 39.74	73 30 54.46	222 06 46 179 42 02	Bald Hill..... Hayes' Ridge	42 08 27 359 42 01	5309.1 5675.9	5805.9 6207.0	3.30 3.53
Craven Tree.....	41 10 39.63	73 30 54.96	222 10 59 179 49 09	Bald Hill..... Hayes' Ridge	42 12 40 359 49 09	5319.4 5679.2	5817.1 6210.6	3.31 3.53
LONG ISLAND SOUND.								
<i>From Housatonic river westw'd.</i>								
Bennet	41 16 37.72	73 05 45.56	311 26 50 242 35 56	South Milford..... West Rock.....	131 30 02 62 41 30	9021.0 13180.0	9865.1 14413.3	5.60 8.19
Stratford Point	41 09 26.27	73 06 45.91	228 03 32 186 01 14	South Milford..... Bennet	48 07 23 6 01 53	10979.0 13382.0	12006.3 14634.2	6.82 8.31
Sherwood	41 12 06.58	73 13 03.89	230 37 40 299 16 36	Bennet	50 42 30	13194.1	14428.7	8.20
Stratford Hill.....	41 13 05.95	73 08 50.56	267 04 25 213 22 52	Stratford Point	119 20 47	10102.6	11047.9	6.28
Gunn	41 13 54.10	73 04 37.76	19 52 52 75 51 30	South Milford..... Bennet	87 09 36 33 24 51	11084.0 7824.0	12121.1 8556.1	6.89 4.86
Old Farms	41 14 50.66	73 08 58.59	356 41 05 285 59 48	Stratford Point	199 51 30	8784.6	9606.6	5.46
				Stratford Hill.....	255 48 53	6072.0	6640.2	3.77
				Stratford Hill.....	176 41 10	3235.0	3537.7	2.01
				Gunn	106 02 35	6319.5	6910.8	3.93

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
<i>Chestnut</i>	41 14 11.07	73 13 54.41	285 49 09 259 55 00	Stratford Hill..... Old Farms	105 52 29 79 58 15	7355.7 6995.0	8044.0 7649.5	4.57 4.35
Stratford Light-house.....	41 09 04.77	73 05 52.95	220 54 46 118 13 41	South Milford..... Stratford Point	40 58 06 298 13 08	10585.9 1401.6	11576.4 1532.7	6.58 0.87
Stratford Beacon.....	41 09 44.65	73 05 54.61	225 50 36 64 37 36	South Milford..... Stratford Point	45 53 55 244 37 02	9717.0 1323.0	10626.2 1446.8	6.04 0.82
Stratford Spire, (cock).....	41 11 17.02	73 07 29.94	150 47 52 120 58 29	Stratford Hill..... Chestnut	330 46 58 300 54 16	3849.0 10441.0	4209.1 11418.0	2.39 6.49
Stratford Spire, (hen).....	41 11 30.42	73 07 31.27	119 04 36 147 55 36	Chestnut	299 00 24	10208.0	11163.2	6.34
Charles' Island Poplar.....	41 11 25.45	73 02 58.79	153 16 20	Stratford Point..... Gunn	327 54 44	3477.0	3802.3	2.16
Milford Spire	41 13 34.23	73 03 12.85	230 41 19 107 14 26	Stratford Point..... Prindle	235 08 13 333 15 15	6449.0 5124.0	7052.4 5603.5	4.01 3.18
Black Rock, (1).....	41 08 36.48	73 12 37.06	259 20 36 174 29 23	Stratford Point..... Sherwood	50 43 58 287 13 30	7233.0 2072.0	7909.8 2265.9	4.49 1.29
Black Rock Light-house	41 08 30.11	73 12 43.87	176 00 32 212 33 20	Sherwood	79 24 27 354 29 05	8329.0 6511.0	9108.3 7120.2	5.18 4.05
Black Rock, (2).....	41 08 32.56	73 12 37.94	258 33 33 174 46 00	Sherwood	356 00 19 32 35 54	6694.0 10097.0	7320.4 11041.8	4.16 6.27
Bridgeport North Spire	41 10 35.20	73 11 06.36	289 17 29 30 00 19	Stratford Point..... Black Rock, (1).....	78 37 25 354 45 43	8373.2 6629.5	9156.7 7249.8	5.21 4.12
					109 20 20 209 59 18	6432.5 4230.0	7034.4 4625.8	4.00 2.63

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.			Distance.		
					°	'	"	Metres.	Yards.	Miles.
Bridgeport Middle Spire	41 10 32.33	73 11 04.66	136 17 39 213 22 57	Sherwood	316	16	01	4021.5	4379.8	2.50
				Stratford Hill	33	24	06	5673.3	6204.2	3.53
Bridgeport South Spire	41 10 30.07	73 11 03.78	288 07 08 31 49 33	Stratford Point	108	08	57	6324.9	6916.7	3.93
				Black Rock, (1)	211	48	33	4125.2	4511.2	2.56
Johnson	41 10 02.41	73 09 43.91	56 43 10 285 02 18	Black Rock, (1)	236	41	09	4829.0	5280.9	3.00
				Stratford Point	105	04	07	4296.0	4698.0	2.67
Milford Point	41 09 47.10	73 04 19.25	215 22 19 134 09 22	S. Milford	35	24	31	8207.7	8975.7	5.10
				Stratford Hill	314	06	23	8808.5	9632.7	5.47
Gould	41 10 55.06	73 16 18.23	244 19 16 309 51 22	Sherwood	64	21	24	5023.0	5493.0	3.12
				Black Rock, (1)	129	52	25	6716.0	7344.4	4.17
Pine Creek Point, (1)	41 07 03.84	73 15 22.22	233 24 40 169 40 11	Black Rock, (1)	53	25	06	4794.0	5220.7	2.97
				Gould	349	39	34	7280.0	7961.2	4.52
Fairfield	41 09 21.47	73 15 13.62	2 41 48 290 49 39	Pine Creek Point, (1)	182	41	42	4250.0	4647.7	2.64
				Black Rock, (1)	110	50	00	3904.0	4269.3	2.43
Fairfield Spire	41 08 33.49	73 14 41.52	19 00 55 268 15 03	Pine Creek Point, (1)	198	56	27	2902.0	3173.5	1.80
				Black Rock, (1)	88	11	01	2923.7	3197.3	1.82
Pavement	41 11 34.88	73 16 57.23	312 54 55 259 46 49	Black Rock, (2)	132	57	46	8255.0	9027.4	5.13
				Sherwood	79	49	23	5523.0	6039.8	3.43
Pine Creek Point, (2)	41 07 11.46	73 15 13.78	235 29 14 163 30 43	Black Rock, (2)	55	30	59	4416.0	4829.2	2.74
				Pavement	343	29	35	8474.0	9266.9	5.27
Cumpo	41 06 47.53	73 20 40.42	264 25 51 210 23 42	Pine Creek Point, (2)	84	29	26	7650.0	8365.8	4.75
				Pavement	30	26	09	10278.0	11239.7	6.39

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

S. Doc. 3.

271

Name of station.	Latitude, ° ' "	Longitude, ° ' "	Azimuth, ° ' "	To station—	Back azimuth, ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Gorham.....	41 10 57.79	73 23 25.63	262 45 27 333 27 51	Pavement..... Cumpo.....	82 49 43 153 29 39	9122.8 8627.0	9976.4 9434.2	5.67 5.36
Merwin.....	41 14 06.65	73 19 37.30	321 24 34 42 23 19	Pavement..... Gorham.....	141 26 20 222 20 49	5987.0 7885.0	6547.2 8622.8	3.72 4.90
Jackson.....	41 15 04.19	73 16 40.27	3 29 45 66 44 21	Pavement..... Merwin.....	183 29 34 246 42 24	6468.0 4491.0	7073.2 4911.2	4.02 2.79
W. Hubbel.....	41 10 14.84	73 15 16.89	221 56 42 309 08 35	Sherwood..... Black Rock, (1).....	41 58 10 129 10 00	4635.0 4805.0	5068.7 5254.6	2.88 2.99
Thorp.....	41 07 56.69	73 18 48.98	288 39 12 212 24 19	Pine Creek Point, (1)..... Gould.....	108 41 29 32 25 58	5090.0 6554.0	5566.3 7167.3	3.16 4.07
Mill Hill.....	41 08 46.82	73 16 22.29	181 20 54 65 38 41	Gould..... Thorp.....	1 20 57 245 37 05	3984.0 3755.0	4356.8 4106.4	2.48 2.33
Bradley.....	41 10 51.42	73 17 10.39	315 32 06 263 16 10	Fairfield..... Gould.....	135 33 24 83 16 44	3886.0 1223.0	4249.6 1337.4	2.42 0.76
Adams.....	41 09 01.00	73 19 16.42	229 28 07 342 06 53	Gould..... Thorp.....	49 30 04 162 07 11	5463.0 2084.0	5974.2 2279.0	3.40 1.30
Levi Hubbel.....	41 08 39.71	73 20 00.31	308 34 31 237 17 31	Thorp..... Adams.....	128 35 18 57 18 00	2127.0 1215.0	2375.2 1328.7	1.35 0.75
Farms Point.....	41 06 53.07	73 18 14.72	157 50 32 265 15 37	Thorp..... Pine Creek Point, (1).....	337 50 09 85 17 30	2118.0 4037.0	2316.2 4414.7	1.32 2.51
Handford.....	41 09 04.24	73 22 06.93	152 21 51 200 27 09	Gorham..... Merwin.....	332 21 00 20 28 47	3953.0 9956.0	4322.9 10887.6	2.46 6.19

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Brown	41 09 59.29	73 25 27.62	289 55 36 237 35 08	Handford	109 57 47	4976.0	5441.6	3.09
Cockenoe's Island.....	41 04 58.89	73 21 00.66	243 08 44 188 01 01	Gorham.....	57 36 28	3367.0	3682.0	2.09
St. John	41 06 55.76	73 25 11.83	272 16 04 198 20 16	Pine Creek Point, (2).....	63 12 32	9063.0	9911.0	5.63
Nash	41 06 02.19	73 25 21.57	187 49 44 257 56 06	Cumpo	8 01 14	3384.0	3700.6	2.10
Calf-pasture Island	41 04 53.79	73 22 43.50	219 17 40 137 23 39	Gorham.....	92 19 02	6336.0	6928.9	3.94
Brushy Ridge.....	41 09 21.76	73 28 40.90	292 57 31 248 00 55	St. John	18 21 25	7865.0	8600.9	4.89
Copp's Island.....	41 03 31.87	73 22 55.36	207 32 28 143 16 17	Cumpo	7 49 51	1667.0	1823.0	1.04
Ram Island.....	41 03 30.29	73 23 52.41	216 20 58 267 53 08	Cumpo	77 59 11	6706.0	7333.5	4.17
Chimon's Island.....	41 04 00.71	73 23 09.20	213 59 37 340 02 05	Brushy Ridge.....	39 19 01	4533.0	4957.2	2.82
Tavern Island.....	41 03 36.57	73 25 00.72	189 14 47 225 51 30	Cumpo	317 22 02	5111.0	5589.2	3.18
Lockwood.....	41 05 32.00	73 28 44.13	180 36 25 294 26 19	Copp's Island.....	113 02 47	12173.0	13312.0	6.35
					68 04 22	7923.0	8664.4	4.92
					27 33 57	6807.0	7443.9	4.23
					323 12 29	13471.0	14731.5	8.37
					36 23 04	7556.0	8263.0	4.70
					87 53 45	1332.0	1456.6	0.83
					34 01 15	6207.0	6787.8	3.86
					160 02 14	946.4	1035.0	0.59
					9 15 49	13789.0	15079.2	8.64
					45 54 21	8461.0	9244.7	5.26
					0 36 26	7087.0	4746.9	4.40
					114 30 08	8944.0	9780.9	5.56

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

S. Doc. 3.

273

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Met. es.	Yards.	Miles.
Greenwich Point, (2)	41 00 07.36	73 33 57.31	295 01 42 343 02 31	Eaton	115 08 44	16629.9	18086.0	10.33
				Sheep	163 04 54	17619.5	18868.2	10.95
Long Neck.....	41 02 08.56	73 28 20.75	326 17 18 64 35 55	Eaton	146 20 40	12966.5	14179.8	8.06
				Greenwich Point, (2)	244 32 15	8705.9	9520.5	5.41
Shippan Point	41 01 09.67	73 31 04.27	309 07 29 64 35 11	Eaton	129 12 38	14207.0	15536.3	8.83
				Greenwich Point, (2)	244 33 17	4476.3	4895.2	2.78
Sheffield Island Light-house...	41 02 52.81	73 24 50.54	187 32 07 218 51 25	Gorham	7 33 03	15090.1	16502.1	9.38
				Cumpo	38 54 00	9300.4	10170.6	5.78
Fish Island.....	41 02 51.82	73 27 08.16	51 47 58 335 36 00	Long Neck	231 47 10	2157.3	2359.4	1.34
				Eaton	155 38 34	13310.5	14556.0	6.42
Sheffield Island, (2)	41 02 47.67	73 25 01.56	348 03 22 68 29 19	Eaton	168 04 33	12260.9	13408.1	7.62
				Greenwich Point, (2)	248 23 27	13456.3	14715.4	8.36
Palmer	41 03 38.30	73 33 46.16	270 41 08 213 52 49	Copp's Island	90 48 17	15195.0	16616.8	9.44
				Brushy Ridge	33 56 10	12765.7	13960.2	7.93
Stanwich.....	41 06 30.81	73 36 30.73	244 15 45 324 05 37	Brushy Ridge	64 20 54	12168.0	13306.6	7.56
				Palmer	144 07 25	6565.3	7179.6	4.08
Purdy	41 03 07.52	73 41 16.06	264 47 28 226 40 13	Palmer	84 52 24	10547.0	11533.9	6.55
				Stanwich	46 43 21	9139.9	9995.1	5.68
Munro	40 56 08.94	73 45 53.61	324 08 50 203 36 45	Harrow	144 13 59	18866.9	20632.3	11.72
				Round Hill	23 40 33	20260.6	22156.4	12.59
Port Chester, (station).....	41 00 06.53	73 40 02.71	338 04 30 14 28 40	Townsend	158 06 58	14135.8	15758.5	8.78
				Sands' Point	194 26 52	15513.3	16964.9	9.64

United States Coast Survey.—Geographical Positions. Section II.—Long Island Sound. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Sandford	41 01 10.85	73 39 36.92	304 47 36 16 53 51	Little Captain's Island..... Port Chester	124 50 45 196 53 34	5863.0 2073.0	6411.6 2267.0	3.64 1.29
Port Chester, (flag-staff)	40 59 54.19	73 39 18.78	169 50 23 110 21 38	Sandford	349 50 01	2402.0	2626.8	1.49
Close	41 04 45.24	73 37 43.74	290 23 45 20 41 41	Port Chester	290 21 09	1095.0	1197.5	0.68
Hobby	41 03 32.68	73 36 39.38	267 31 35 355 04 17	Palmer	110 26 21	5917.8	6471.5	3.68
Webb	41 06 52.42	73 33 49.85	359 10 29 79 55 48	Port Chester	200 40 09	9188.7	10048.5	5.71
Norrotton	41 03 14.11	73 30 32.99	99 24 00 47 51 41	Palmer	87 33 29	4048.0	4426.8	2.52
Norrotton Point	41 03 16.80	73 25 59.23	57 31 11 343 13 33	Little Captain's Island..... Long Neck..... Eaton	175 05 30 179 10 31 259 54 02	7750.7 5988.3 3820.0	8475.9 6548.6 4177.4	4.82 3.72 2.37
Southport Spire.....	41 08 04.65	73 16 34.68	46 35 18 98 03 46	Palmer	279 21 53	4570.6	4998.3	2.84
Norwalk Spire.....	41 07 05.34	73 24 09.85	188 10 39 78 26 32	Little Captain's Island..... Copp's Island..... Brushy Ridge.....	227 48 00 237 29 38 163 15 22	10650.0 3918.1 13466.2	11646.6 4284.7 14726.2	6.62 2.43 8.37
Horse Neck Spire.....	41 02 03.47	73 37 04.40	49 07 49 345 52 56	Long Neck..... Gorham..... St. John	226 31 08 277 55 38 8 11 08	12235.3 17100.0 7243.7	13380.2 18700.0 7921.5	7.66 10.62 4.50
Stamford Spire, (northeast)	41 03 12.11	73 31 43.09	132 22 40 267 49 50	St. John	258 25 51	1475.7	1613.8	0.92
				Port Chester	229 05 53	5510.3	6025.9	3.42
				Little Captain's Island.....	165 54 15	5125.3	5603.9	3.18
				Stanwich.....	312 19 26	9092.2	9942.9	5.65
				Norrotton.....	87 50 36	1637.9	1791.2	1.02

United States Coast Survey.—Geographical Positions. Section II.—Vicinity of New York. Sketch B, No. 2.

S. Doc. 3.

275

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Stamford Spire, (southwest)	41 03 10.19	73 32 01.96	134 35 21 266 39 53	Stanwich..... Norroton	314 32 19 86 40 51	8813.0 2081.0	9637.6 2275.7	5.48 1.29
Davenport	41 07 32.10	73 31 22.67	315 02 36 351 43 13	Lockwood..... Norroton.....	135 03 16 171 42 41	5234.9 8041.6	5724.7 8794.1	3.26 5.00
Scofield	41 08 18.35	73 34 32.93	329 09 16 287 48 23	Norroton	149 11 54	10927.7	11950.2	6.79
				Davenport	107 51 32	4660.8	5096.9	2.90
VICINITY OF NEW YORK.								
Quimby.....	41 08 42.74	73 43 52.77	311 31 27 57 24 11	Round Hill..... Buttermilk Hill.....	131 33 52 237 21 16	7073.7 7371.3	7735.6 8061.0	4.40 4.58
Rockhill	41 09 41.12	73 43 02.78	51 58 01 327 32 52	Buttermilk Hill..... Round Hill.....	231 54 49 147 35 05	9367.9 7691.8	10245.1 8411.5	5.82 4.78
Sarles	41 08 55.39	73 46 59.60	275 06 07 22 59 24	Quimby	95 08 10	4373.7	4783.0	2.72
				Buttermilk	202 58 32	4740.3	5183.9	2.95
Hunt's Hill.....	41 11 05.78	73 45 46.41	22 59 30 329 00 31	Sarles	202 58 42	4368.8	4777.6	2.71
				Quimby	149 01 46	5146.3	5687.8	3.20
Knapp	41 12 17.17	73 41 45.12	49 41 55 24 14 20	Sarles	229 38 26	9615.5	10515.2	5.98
				Quimby	204 12 57	7249.9	7928.3	4.50
Bussing.....	41 09 33.82	73 40 27.59	160 17 03 71 47 18	Knapp	340 16 11	5350.1	5850.7	3.32
				Quimby	251 45 03	5036.4	5507.7	3.13
Aspen Hill.....	41 13 34.20	73 38 25.57	20 59 30 62 54 54	Bussing	200 58 09	7940.9	8683.9	4.93
				Knapp.....	242 52 42	5220.1	5708.5	3.24

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Bedford Spire	41 12 25.52	73 38 30.26	86 44 33 182 57 12	Knapp	266 42 23	4545.6	4970.9	2.83
				Aspen Hill	2 57 14	2121.3	2309.8	1.32
Great Hill	41 10 56.02	73 36 15.45	66 41 10 148 09 34	Bussing	246 38 24	6400.5	6999.4	3.98
				Aspen Hill	328 08 09	5743.8	6281.3	3.57
Poundridge	41 13 01.53	73 34 06.15	37 53 55 99 29 24	Great Hill	217 52 31	4905.2	5364.2	3.05
				Aspen Hill	279 26 33	6125.1	6698.2	3.80
Poundridge Church	41 12 29.86	73 34 10.37	108 29 14 58 21 06	Aspen Hill	288 26 26	6271.4	6858.2	3.90
				Bussing	238 16 57	10335.4	11302.5	6.42
Ambler	41 12 21.06	73 37 14.19	143 37 15 88 54 56	Aspen Hill	323 36 29	2802.5	3064.7	1.74
				Knapp	268 51 58	6311.5	6902.1	3.92
Prospect	41 11 03.19	73 40 34.49	144 10 22 46 52 17	Knapp	324 09 34	2811.2	3074.2	1.75
				Quimby	226 50 06	6335.1	6927.9	3.93
Vail's Pole	41 11 55.30	73 50 47.75	282 14 29 316 12 05	Hunt's Hill	102 17 46	7185.7	7858.1	4.46
				Sarles	136 14 35	7685.7	8404.8	4.78
Kakeout Hill	41 05 18.17	73 50 22.13	230 53 03 215 10 07	Buttermilk Hill	50 54 24	3703.4	4049.9	2.30
				Sarles	35 12 21	8198.4	8965.5	5.09
Fields West	41 02 14.86	73 43 14.48	311 25 16 18 14 41	Port Chester	131 27 22	5976.0	6535.2	3.71
				Munro	198 12 57	11883.0	12994.9	7.38
Theal	40 58 13.46	73 41 39.17	212 53 39 163 20 38	Port Chester	32 54 42	4150.0	4538.3	2.58
				Fields West	343 19 34	7765.9	8492.5	4.82
Tompkin	40 58 32.95	73 45 35.16	208 40 27 275 39 43	Fields West	28 42 12	7802.7	8532.8	4.85
				Theal	95 42 32	6005.0	6566.9	3.73

United States Coast Survey.—Geographical Positions. Section II.—Vicinity of New York. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Spyhill.....	40 59 45.64	73 46 15.87	265 44 22 222 38 22	Port Chester..... Fields West.....	85 48 27 42 40 21	8744.0 6254.0	9562.2 6839.2	5.43 3.88
Greensburgh, (2).....	41 00 33.92	73 48 37.51	247 32 40 334 52 08	Fields West..... Munro.....	67 36 11 154 53 55	8161.2 9026.8	8924.8 9871.4	5.07 5.61
Greensburgh, (3).....	40 59 31.71	73 49 31.44	240 12 49 320 49 17	Fields West..... Munro.....	60 16 55 140 51 39	10142.0 8065.2	11091.0 8819.8	6.30 5.01
Valentine, (2)	40 55 38.34	73 51 34.24	201 44 27 263 12 57	Greensburgh, (3)..... Munro.....	21 45 38 83 16 30	7749.3 8023.9	8474.4 8774.7	4.81 4.98
Shonhard	40 57 05.42	73 52 47.85	225 29 12 280 09 20	Greensburgh, (3)..... Munro.....	45 31 20 100 13 51	6437.0 9843.0	7039.3 10764.0	4.00 6.12
Boompes Hook	40 57 59.00	73 54 24.36	247 18 24 306 12 35	Greensburgh, (3)..... Shonhard	67 21 36 126 13 38	7420.0 2797.0	8114.3 3058.7	4.61 1.74
Didery.....	40 57 59.98	73 50 13.95	199 21 11 64 57 12	Greensburgh, (3)..... Shonhard	19 21 39 244 55 31	2998.5 3972.5	3279.1 4344.2	1.86 2.47
Fort Washington.....	40 51 08.21	73 55 59.40	6 47 18 292 28 50	Mount Prospect..... Kissam	186 46 11 112 37 38	20266.8 20510.2	22163.1 22429.3	12.59 12.74
Van Dyne.....	40 43 37.28	73 50 49.45	242 37 23 152 26 44	Kissam	62 42 49	13158.7	14389.9	8.17
				Fort Washington.....	332 23 21	15691.9	17160.2	9.75
Givan.....	40 52 34.26	73 50 31.76	313 00 18 70 57 01	Kissam	133 05 32	15411.6	16853.6	9.58
				Fort Washington.....	250 53 27	8118.0	8877.6	5.04
Throg's Neck.....	40 48 16.29	73 47 12.61	187 13 25 149 38 24	Munro.....	7 14 17	14694.0	16068.9	9.13
				Givan.....	329 36 14	9223.0	10086.0	5.73

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	Q ' "		Q ' "	Metres.	Yards.	Miles.
Throg's Neck Light.....	40 48 16.87	73 47 08.96	186 54 12 149 07 17	Munro..... Givan.....	6 55 01 329 05 04	14667.2 9252.0	16039.6 10117.7	9.11 5.75
Westerfeld.....	40 54 27.21	73 55 40.24	313 51 44 249 06 42	Throg's Neck..... Valentine, (2)	133 56 46 69 09 23	16498.0 6159.0	18041.7 6735.3	10.25 3.83
Lydecker	40 52 27.59	73 56 34.12	268 33 35 229 59 55	Givan..... Valentine, (2)	88 37 33 50 03 12	8492.0 9164.0	9286.6 10021.5	5.28 5.69
Wolf Pit.....	40 47 12.43	73 48 57.18	167 25 28 273 43 18	Givan..... Kissam	347 24 24 93 47 30	10170.2 9071.9	11121.9 9920.8	6.32 5.64
Rapalyee.....	40 46 11.70	73 52 01.47	246 32 44 148 39 07	Wolf Pit..... Fort Washington.....	66 34 47 328 36 31	4709.4 10711.2	5150.1 11713.3	2.93 6.71
Polhemus	40 46 43.30	73 54 28.05	165 19 45 252 13 18	Fort Washington..... Lawrence	345 18 45 72 15 35	8446.3 5315.0	9236.6 5812.4	5.25 3.30
Wardell	40 46 23.65	73 55 35.60	176 21 57 249 02 58	Fort Washington..... Polhemus	356 21 44 69 03 42	8794.8 1695.8	9617.7 1854.5	5.46 1.05
Great Mill Rock.....	40 46 48.52	73 55 58.89	274 19 07 324 33 15	Polhemus	94 20 06 144 33 30	2135.9 941.9	2335.8 1030.0	1.33 0.58
Leggett	40 48 51.46	73 53 02.21	297 58 57 343 52 33	Wolf Pit..... Rapalyee.....	118 01 41 163 53 13	6504.8 5129.1	7113.4 5609.0	4.04 3.19
Flushing Bay.....	40 45 27.08	73 50 48.58	218 47 06 128 50 46	Wolf Pit..... Rapalyee.....	38 48 23 308 49 59	4169.2 2194.4	4559.3 2399.7	2.59 1.36
Riker's Island	40 47 20.63	73 52 52.20	330 46 13 62 53 19	Rapalyee..... Polhemus	150 46 46 242 52 16	2435.8 2524.8	2663.7 2761.0	1.51 1.57

United States Coast Survey.—Geographical Positions. Section II.—New York Bay. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
South Brother	40 47 44.95	73 53 33.32	323 10 04 34 00 59	Rapalyee	143 11 04 214 00 23	3592.9 2293.6	3929.1 2508.2	2.23 1.42
Hunt's Point	40 48 02.92	73 52 08.19	295 04 23 357 22 05	Lawrence	115 05 16 177 22 10	1968.1 3434.1	2152.3 3755.4	1.22 2.13
Prospect Hill	40 47 02.43	73 56 57.16	279 34 10 190 07 04	Polhemus	99 35 48 10 07 42	3545.3 7700.7	3877.0 8421.3	2.20 4.78
NEW YORK BAY.								
Howard	40 37 36.73	74 05 03.89	163 34 41 243 19 10	Weasel	343 30 54 63 36 48	28862.7 42542.3	31563.4 46543.2	17.93 26.43
Mount Prospect	40 40 15.73	73 57 41.40	140 54 53 64 47 02	Weasel	320 46 16 244 42 14	29373.5 11493.6	32122.0 12569.1	18.25 7.14
Highwood	40 46 07.74	74 00 44.39	338 24 11 21 09 18	Mount Prospect	158 26 11 201 06 28	11675.5 16897.3	12768.0 18478.4	7.25 10.50
Vetts	40 44 13.52	73 54 08.90	34 14 16 110 49 55	Mount Prospect	214 11 58 290 45 37	8869.3 9922.6	9699.2 10851.1	5.51 6.16
Luqueer	40 40 43.56	73 59 33.42	170 33 00 229 35 56	Highwood	350 32 22 49 39 35	10136.3 9997.6	11084.8 10933.1	6.30 6.21
Bushwick	40 43 39.99	73 57 13.41	132 39 21 31 08 34	Highwood	312 37 05 211 07 03	6727.2 6357.5	7356.7 6952.4	4.18 3.95
Stevens	40 44 38.49	74 01 06.54	288 14 14 343 12 35	Bushwick	108 16 47 163 13 37	5759.6 7568.8	6298.5 8277.0	3.58 4.70

United States Coast Survey.—Geographical Positions. Section II.—New York Bay. Sketch B, No. 2.

280

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth,	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Fort Green.....	40 41 28.30	73 58 14.73	340 43 17 53 14 58	Mount Prospect..... Luqueer	160 43 39 233 14 06	2371.1 2305.7	2593.0 2521.4	1.47 1.43
Brooklyn Institute	40 41 47.24	73 59 21.97	290 18 02 7 47 37	Fort Green..... Luqueer	110 18 47 187 47 30	1682.9 1982.2	1840.4 2167.7	1.04 1.23
Brooklyn, (Cath. Ch. spire).	40 41 46.86	73 58 54.18	301 42 57 25 15 54	Fort Green..... Luqueer	121 43 24 205 15 28	1088.6 2158.6	1190.5 2360.6	0.68 1.34
Van Cott.....	40 43 22.83	73 56 37.13	121 52 45 14 39 27	Bushwick	301 52 30 194 38 47	1002.4 5964.6	1096.2 6522.7	0.62 3.71
New York City Hall.....	40 42 43.16	74 00 03.09	140 11 54 36 58 12	Weasel	320 04 49 216 54 58	23748.1 11620.5	25970.2 12707.8	14.76 7.22
Bushwick Spire.....	40 42 53.17	73 56 14.15	136 05 21 22 52 44	Bushwick	316 04 42 202 51 47	2004.5 5270.3	2192.1 5763.4	1.25 3.27
Conover	40 44 10.94	73 55 31.33	267 38 11 22 50 08	Vetts	87 39 06 202 48 43	1935.3 7870.8	2116.4 8607.3	1.20 4.89
Blackwell's Island.....	40 45 04.10	73 57 15.14	303 56 53 359 06 12	Conover	123 58 03 179 06 13	2935.7 2594.6	3210.4 2837.4	1.82 1.61
Williamsburgh, (flag-staff)...	40 43 10.45	73 57 26.54	198 41 22 251 45 31	Bushwick	18 41 30 71 45 53	961.9 1220.5	1051.9 1334.7	0.60 0.76
St. John's Church Spire.....	40 43 13.34	74 00 04.50	257 25 40 328 28 13	Vetts	77 29 32 148 29 46	8547.4 6426.2	9347.2 7027.5	5.31 3.99
State Prison.....	40 43 58.05	74 00 13.60	266 45 57 332 27 56	Vetts	86 50 55 152 29 35	8570.0 7733.0	9371.9 8456.6	5.33 4.80

United States Coast Survey.—Geographical Positions. Section II.—New York Bay. Sketch B, No. 2.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
St. Mark's Spire	40 43 46.13	73 58 55.03	262 47 45 345 04 14	Vetts	82 51 05	6766.5	7399.6	4.20
				Mount Prospect.....	165 05 15	6715.3	7343.7	4.17
Almshouse	40 44 18.21	73 58 15.20	271 24 53 353 56 30	Vetts	91 27 35	5780.0	6320.9	3.59
				Mount Prospect.....	173 56 52	7521.0	8224.7	4.67
Waterworks	40 43 56.44	73 59 03.12	265 36 35 344 15 18	Vetts	85 39 47	6922.8	7570.6	4.30
				Mount Prospect.....	164 16 11	7072.5	7734.3	4.39
Williamsburgh Spire.....	40 42 44.19	73 57 24.75	239 02 25 4 52 51	Vetts	59 04 33	5357.9	5859.2	3.33
				Mount Prospect.....	184 52 40	4595.8	5025.8	2.86
Shot Tower.....	40 45 16.07	73 57 26.99	292 31 59 2 05 33	Vetts	112 34 14	5031.0	5501.7	3.13
				Mount Prospect.....	182 05 24	9269.8	10137.2	5.76
Naval Hospital, (flag-staff)...	40 41 52.96	73 57 36.73	228 20 51 2 05 42	Vetts	48 23 07	6525.5	7136.1	4.05
				Mount Prospect.....	182 05 39	3000.6	3281.3	1.86
Navy Yard, (flag-staff)	40 42 02.40	73 58 30.63	227 01 47 340 38 12	Van Cott.....	47 02 52	3640.3	3980.9	2.26
				Mount Prospect.....	160 38 44	3486.9	3713.2	2.17
New York Trinity Ch. Spire.	40 42 25.71	74 00 24.29	249 17 08 316 20 13	Vetts	69 21 18	9415.5	10296.5	5.85
				Mount Prospect.....	136 21 59	5540.6	6059.0	3.44
Brooklyn Trinity Ch. Spire..	40 40 56.33	73 57 43.06	219 33 01 358 13 12	Vetts	39 35 26	7889.9	8628.2	4.90
				Mount Prospect.....	178 13 13	1252.9	1370.1	0.78
Navy Yard, (ship-house)	40 42 08.08	73 58 24.57	31 48 16 343 41 35	Luqueer	211 47 31	3067.5	3354.5	1.90
				Mount Prospect.....	163 42 03	3610.7	3948.6	2.24
Mount Mitchell.....	40 24 27.77	74 00 06.30	163 58 04 215 34 07	Howard.....	343 54 51	25321.9	27691.2	15.73
				Harrow	35 48 28	53359.0	58351.8	33.15

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Bloomfield	40 32 04.01	74 19 08.84	242 36 25 297 30 00	Howard..... Mount Mitchell.....	62 45 35 117 42 21	22363.7 30368.2	24456.2 33209.7	13.89 18.87
Toad	40 35 58.43	74 06 34.94	336 43 13 67 53 01	Mount Mitchell..... Bloomfield.....	156 47 25 247 44 50	23183.3 19149.8	25352.6 20941.6	14.40 11.90
Point Comfort	40 27 20.79	74 07 45.05	118 33 14 185 55 40	Bloomfield..... Toad	298 25 48 5 56 25	18308.5 16050.2	20021.6 17552.0	11.37 9.97
Sandy Hook	40 27 42.18	74 00 04.80	159 01 56 235 05 56	Howard..... Pavilion.....	338 58 41 55 15 46	19641.4 26065.2	21479.2 28504.1	12.20 16.20
Sandy Hook Light-house	40 27 39.41	73 59 48.69	191 26 34 234 27 59	Wyckoff..... Pavilion.....	11 27 44 54 37 40	12856.1 25805.2	14059.1 28219.8	7.99 16.03
Great Kills.....	40 32 21.06	74 06 50.38	7 58 28 311 58 46	Point Comfort..... Sandy Hook.....	187 57 52 132 03 09	9351.8 12852.5	10226.8 14055.1	5.81 7.98
Compton.....	40 26 19.74	74 05 09.94	117 18 15 168 05 04	Point Comfort..... Great Kills.....	297 16 20 348 03 45	4111.1 11392.2	4495.8 12458.2	2.55 7.08
Knipphausen.....	40 38 28.32	74 04 36.92	21 43 12 251 12 53	Howard..... Mount Prospect.....	201 42 55 71 17 24	1712.8 10307.3	1873.1 11271.7	1.06 6.40
Caven Point	40 41 31.36	74 03 59.07	284 42 06 8 57 09	Mount Prospect..... Knipphausen.....	104 46 17 188 56 44	9169.6 5715.0	10027.6 6249.8	5.69 3.55
Constable's Point	40 39 23.52	74 05 25.61	261 33 26 326 06 05	Mount Prospect..... Knipphausen.....	81 38 29 146 06 37	11021.2 2051.2	12052.4 2243.1	6.85 1.27
Palmerpaw	40 40 38.24	74 05 39.32	273 29 46 351 32 22	Mount Prospect..... Howard.....	93 34 58 171 32 45	11244.7 5659.7	12296.8 6189.3	6.99 3.52

United States Coast Survey.—Geographical Positions. Section II.—New York Bay. Sketch B, No. 2.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Bedloe's Island, (flag-staff) . . .	40 41 17.48	74 02 20.85	286 09 36 31 30 03	Mount Prospect Kniphausen	106 12 38 211 28 34	6832.8 6118.3	7472.2 6690.8	4.24 3.80
Gibbet Island, (tree)	40 41 55.72	74 02 05.49	74 16 08 29 05 03	Caven Point Kniphausen	254 14 54 209 03 24	2770.1 7318.9	3029.3 8003.7	1.72 4.55
Jersey City, (flag-staff)	40 42 52.43	74 01 57.20	48 51 13 24 44 16	Caven Point Kniphausen	228 49 53 204 42 31	3799.4 8967.3	4154.9 9806.4	2.36 5.57
Castle Garden, (flag-staff)	40 42 02.72	74 00 32.91	40 56 07 78 42 56	Kniphausen Caven Point	220 53 28 258 40 42	8749.9 4935.4	9568.6 5397.2	5.44 3.07
Governor's Island, or Fort Columbus, (flag-staff.)	40 41 27.77	74 00 40.70	297 48 57 60 12 48	Mount Prospect Constable's Point	117 51 01 240 09 49	4760.9 7710.1	5206.4 8431.4	2.96 4.79
Fort Tompkins	40 36 13.27	74 03 04 33	294 24 29 36 36 45	Wyckoff Great Kills	114 27 47 216 34 18	7851.6 8918.8	8586.3 9753.3	4.88 5.54
Fort Hamilton	40 36 26.05	74 01 38.71	305 19 21 44 09 33	Wyckoff Great Kills	125 21 43 224 06 09	6296.5 10526.0	6885.7 11510.9	3.91 6.54
Owl's Head	40 38 23.82	74 01 40.71	73 05 59 26 00 44	Howard Fort Tompkins	253 03 47 205 59 50	4990.0 4479.8	5456.9 4899.0	3.10 2.78
Coney Island, (NW.)	40 34 39.44	74 00 08.71	276 40 47 147 14 58	Wyckoff Fort Hamilton	96 42 11 327 14 00	3041.9 3909.4	3326.5 4275.2	1.89 2.42
Benson	40 35 56.02	73 59 53.86	110 35 30 8 24 26	Fort Hamilton Coney Island, (NW.)	290 34 22 188 24 16	2632.0 2388.0	2878.2 2611.5	1.64 1.48
Elm Tree	40 33 43.95	74 05 23.36	262 32 48 226 34 04	Wyckoff Fort Hamilton	82 37 16 46 36 10	10510.2 7273.6	11493.6 7954.2	6.53 4.52

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Prince's Bay Light-house....	40 30 24.80	74 12 29.84	285 53 09 249 47 36	Sandy Hook..... Wyckoff.....	106 01 11 69 57 02	18248.1 21792.4	19955.6 23831.5	11.34 13.54
Red Hook.....	40 40 27.50	74 00 38.90	49 47 24 20 50 59	Howard..... Owl's Head.....	229 44 31 200 50 17	8154.2 4082.1	8917.2 4464.1	5.07 2.54
Battery, (flag-staff).....	40 42 02.71	74 00 32.91	18 16 20 40 56 00	Fort Tompkins..... Kniphausen.....	198 14 41 220 53 21	11349.6 8751.0	12411.6 9569.8	7.05 5.45
Romer Beacon.....	40 30 44.09	74 00 30.11	153 11 12 207 02 28	Howard..... Wyckoff.....	333 08 14 27 04 05	14263.2 7752.5	15597.8 8477.9	8.86 4.82
Robin's Reef Light-house....	40 39 23.81	74 03 36.80	259 06 29 31 47 25	Mount Prospect..... Howard.....	79 10 20 211 46 29	8499.4 3885.1	9294.7 4248.6	5.28 2.41
Fire Signal.....	40 37 42.04	74 05 00.48	163 19 59 243 28 10	Weasel..... Harrow.....	343 16 10 63 45 45	28728.7 42397.6	31416.8 46364.7	17.85 26.34
Moncey.....	40 30 09.06	74 12 48.52	244 13 42 305 59 25	Great Kills..... Point Comfort.....	64 17 25 126 02 42	9366.9 8832.8	10243.4 9659.3	5.82 5.49
Morgan.....	40 28 01.06	74 15 39.33	276 20 08 221 00 34	Point Comfort..... Toad.....	96 25 16 41 06 28	11240.9 19515.9	12292.7 21342.0	6.98 12.13
Beers.....	40 23 30.96	74 11 06.29	144 21 00 195 27 53	Bloomfield..... Toad.....	324 15 47 15 28 51	19483.4 23922.1	21306.5 26160.5	12.11 14.86
Cole, (Staten Island).....	40 31 52.01	74 13 46.22	92 49 15 346 17 02	Bloomfield..... Beers.....	272 45 45 166 18 45	7601.2 15905.8	8312.4 17394.1	4.72 9.88
South Amboy.....	40 28 44.61	74 16 59.98	153 45 18 218 15 46	Bloomfield..... Cole.....	333 43 54 38 17 52	6857.7 7363.0	7499.4 8051.9	4.26 4.57

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Ward.....	40 29 41.42	74 14 32.07	27 07 48 250 45 05	Morgan..... Moncey.....	207 07 04 70 46 12	3476.5 2582.6	3801.8 2824.3	2.16 1.61
Conasconck Point.....	40 27 30.90	74 10 24.21	145 10 40 97 12 20	Moncey..... Morgan.....	325 09 06 277 08 55	5945.2 7480.6	6501.5 8180.6	3.69 4.65
Matayan Point.....	40 26 50.28	74 12 19.53	173 40 46 245 15 57	Moncey..... Conasconck Point.....	353 40 28 65 17 13	6168.7 2992.1	6745.9 3272.1	3.83 1.86
Chestnaquack.....	40 27 37.43	74 14 43.39	118 59 17 184 00 30	Morgan..... Ward.....	298 58 41 4 00 38	1505.9 3833.3	1646.8 4192.0	0.94 2.38
Stillwell, or Pigeon Hill.....	40 24 24.49	74 04 23.33	166 45 12 205 49 25	Great Kills..... Wyckoff.....	346 43 36 25 53 34	15100.9 20682.6	16513.9 22617.9	9.38 12.85
Perth Amboy, (south spire)...	40 30 10.68	74 15 35.93	219 33 21 124 54 51	Cole..... Bloomfield.....	39 34 32 304 52 32	4054.1 6110.1	4433.4 6681.8	2.52 3.80
INTERIOR OF NEW JERSEY.								
Sayre.....	40 40 43.56	74 16 57.58	288 54 13 10 54 39	Howard..... Bloomfield.....	109 01 58 190 53 14	17727.5 16319.5	19386.3 17846.5	11.01 10.14
Bergen Neck.....	40 45 49.40	74 02 16.62	14 30 18 135 58 39	Howard..... Weasel.....	194 28 28 315 53 02	15695.0 17376.8	17163.6 19002.7	9.75 10.80
Crane, (2).....	40 50 05.42	74 12 48.86	334 40 12 18 37 35	Howard..... Sayre.....	154 45 15 198 34 53	25539.5 18285.4	27929.2 19996.4	15.87 11.36
Randolph.....	40 36 41.81	74 23 20.32	230 17 47 325 21 37	Sayre..... Bloomfield.....	50 21 59 145 24 20	11681.7 10411.2	12774.8 11385.4	7.26 6.47

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Banta	40 53 09.94	74 00 39.66	9 29 59 85 39 36	Bergen Neck	189 28 57	13776.5	15065.6	8.56
				Weasel	265 32 55	14387.0	15733.2	8.94
Bury	40 50 26.17	74 05 02.57	230 36 33 335 29 25	Banta	50 39 21	7963.4	8708.5	4.95
				Bergen Neck	155 31 13	9381.1	10258.9	5.83
Vreeland	40 49 58.12	74 00 19.67	19 39 14 108 02 31	Bergen Neck	199 37 57	8149.6	8912.2	5.06
				Weasel	287 55 37	15578.2	17035.8	9.68
Cherry Hill	40 54 43.31	73 57 52.37	21 26 18 77 45 51	Vreeland	201 24 42	9445.6	10329.4	5.87
				Weasel	257 37 20	18686.9	20435.4	11.61
Aquackanonk	40 51 01.13	74 07 25.80	322 58 08 77 14 07	Bergen Neck	143 01 30	12039.8	13166.4	7.48
				Crane, (2)	257 10 38	7760.1	8486.2	4.82
Schuyler	40 46 46.28	74 08 10.17	133 15 37 187 31 48	Crane, (2)	313 12 39	8965.5	9804.4	5.57
				Aquackanonk	7 32 19	7928.2	8670.0	4.92
Kingsland	40 47 45.16	74 07 12.75	211 32 54 297 11 17	Bury	31 34 19	5828.3	6373.7	3.62
				Bergen Neck	117 14 30	7807.4	8537.9	4.85
Van Riper	40 53 34.04	74 08 04.34	349 09 52 46 01 16	Aquackanonk	169 10 17	4802.0	5251.3	2.98
				Crane, (2)	225 58 12	9262.7	10129.4	5.75
Terhune	40 51 38.11	74 04 36.76	73 56 35 126 21 52	Aquackanonk	253 54 44	4119.8	4505.3	2.56
				Van Riper	306 19 35	6033.7	6598.3	3.75
Wallace	40 44 30.41	74 10 56.09	217 01 45 258 38 43	Bury	37 05 37	13750.9	15037.6	8.54
				Bergen Neck	78 44 23	12425.7	13588.4	7.72
Bird	40 39 03.13	74 10 08.69	290 22 59 221 26 30	Howard	110 26 17	7641.1	8356.1	4.75
				Bergen Neck	41 31 38	16727.2	18292.4	10.39

United States Coast Survey.—Geographical Positions. Section II.—Interior of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.		Longitude.		Azimuth.		To station—	Back azimuth.		Distance.	Distance.	Distance.
	°	' "	°	' "	°	' "		°	' "	Metres.	Yards.	Miles.
Newark Neck.....	40	42 44.97	74	08 00.00	336 28 26 23 50 25	Howard..... Bird.....	156 30 20 203 49 01	10367.6 7479.7	11337.7 8179.6	6.44 4.65		
(b)	40	40 27.31	74	06 58 15	59 53 41 161 07 35	Bird..... Newark	239 51 37 341 06 55	5173.2 4487.0	5657.3 4906.9	3.22 2.79		
(a)	40	41 22.32	74	08 08.46	315 46 19 33 20 36	(b)..... Bird.....	135 47 05 213 19 18	2367.2 5138.2	2588.7 5619.0	1.47 3.19		
(c)	40	42 40.37	74	06 09.98	93 09 00 15 24 39	Newark Neck..... (b).....	273 07 48 195 24 07	2585.9 4256.9	2827.9 4655.2	1.61 2.64		
Bergen, (spire).....	40	43 39.51	74	03 43.22	206 52 51 74 25 43	Bergen Neck..... Newark Neck.....	26 53 47 254 22 49	4492.0 6256.1	4912.3 6841.5	2.79 3.89		
Elizabethtown, (spire).....	40	39 42.84	74	12 36.97	290 01 53 232 06 45	Howard..... Bergen Neck.....	110 06 49 52 13 31	11332.8 18434.0	12393.2 20158.9	7.04 11.45		
Rahway, (spire).....	40	36 51.04	74	16 32.11	264 57 31 175 14 00	Howard..... Sayre.....	85 04 59 355 13 43	16235.7 7196.3	17754.9 7869.7	10.09 4.47		
Vanhorne, (2)	40	39 05.63	74	08 06.80	88 28 08 181 21 05	Bird..... Newark Neck.....	268 26 49 1 21 10	2864.5 6766.9	3132.5 7400.1	1.78 4.20		
Shooter's Island.....	40	38 34.24	74	09 20.04	286 23 47 127 57 02	Howard..... Bird.....	106 26 33 307 56 30	6274.7 1449.2	6861.8 1584.8	3.90 0.90		
Rowan	40	38 51.54	74	07 13.72	350 18 34 94 59 06	Toad..... Bird.....	170 18 59 274 57 12	5416.0 4126.0	5922.8 4512.1	3.37 2.56		
Praal, (Staten Island).....	40	37 01.78	74	11 44.57	211 02 23 263 26 01	Bird..... Howard.....	31 03 27 83 30 23	4368.6 9478.3	4777.4 10365.2	2.71 5.89		

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Mets.	Yards.	Miles.
Williams, (2).....	40 34 51.18	74 12 31.94	195 27 05 256 05 13	Praal..... Toad	15 27 36 76 09 06	4179.2 8646.8	4570.3 9455.9	2.60 5.37
Doty, (Staten Island).....	40 33 24.29	74 12 10.39	238 53 46 169 17 33	Toad	58 57 24	9210.8	10072.7	5.72
				Williams, (2).....	349 17 19	2727.2	2982.4	1.69
Ellis, (2) Staten Island.....	40 33 39.39	74 10 48.76	76 22 52 132 23 13	Doty	256 21 59	1975.9	2160.8	1.23
				Williams, (2).....	312 22 06	3285.1	3592.5	2.04
Zellis, (2).....	40 32 43.02	74 16 17.64	336 40 10 293 48 46	Beers.....	156 43 30	18538.9	20273.6	11.53
				Cole.....	113 50 24	3894.9	4259.3	2.42
Shotwell.....	40 32 45.43	74 15 01.06	87 39 05 313 05 18	Zellis, (2).....	267 38 15	1803.4	1972.2	1.12
				Cole.....	133 06 06	2411.4	2637.0	1.50
Woodbridge.....	40 33 22.51	74 14 20.83	10 35 52 246 17 31	Morgan.....	190 35 01	10084.9	11028.5	6.27
				Toad	66 22 34	11964.6	13084.1	7.43
Woodbridge, (spire).....	40 33 39.79	74 16 06.26	8 41 42 315 14 36	Zellis, (2).....	188 41 35	1771.3	1937.0	1.10
				Cole.....	135 16 07	4680.4	5118.3	2.91
Throckmorton.....	40 15 01.08	74 10 28.68	219 59 18 163 19 28	Mount Mitchell.....	40 06 00	22831.7	24968.1	14.19
				Beacon Hill	343 17 36	14253.6	15587.3	8.85
Baird.....	40 14 07.05	74 24 31.26	265 08 28 225 49 40	Throckmorton.....	85 17 32	19983.1	21852.9	12.42
				Beacon Hill	45 56 53	22008.1	24067.4	13.67
Bound Brook.....	40 34 56.66	74 31 37.57	311 53 19 345 20 45	Beacon Hill	132 05 06	34713.2	27961.3	21.57
				Baird	165 25 15	39830.0	43556.9	24.75
Grandon.....	40 15 44.62	74 13 35.86	229 44 42 181 30 57	Mount Mitchell.....	49 53 26	25008.6	27348.6	15.54
				Beacon Hill	1 31 06	12314.6	13466.9	7.65

United States Coast Survey.—Geographical Positions. Section II.—Interior of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Debow.....	40 10 55.37	74 25 16.89	250 04 44 218 26 03	Throckmorton	70 14 17	22327.0	24416.1	13.87
				Beacon Hill	38 33 45	27127.8	29666.1	16.85
Newell.....	40 11 41.15	74 14 05.77	182 58 45 219 46 50	Beacon Hill	2 59 14	19839.9	21696.3	12.33
				Throckmorton	39 49 10	8018.2	8768.5	4.98
Freehold Spire, (court-house)	40 15 34.38	74 16 08.50	197 16 05 277 10 19	Beacon Hill	17 17 52	13224.9	14462.3	8.22
				Throckmorton	97 19 58	8117.6	8877.2	5.04
Princeton Seminary, (cupola)	40 20 40.00	74 39 34.26	299 31 29 264 55 42	Baird.....	119 41 13	24529.9	26825.1	15.24
				Beacon Hill	85 12 40	37231.2	40714.9	23.13
Princeton College,* (cupola).	40 20 52.06	74 39 15.26	.....	Princeton Seminary, (cupola).	.....	583.0	637.6	0.36
Sandhills	40 24 27.30	74 32 19.08	277 59 09 329 57 27	Beacon Hill	98 11 26	27084.3	29618.6	16.83
				Baird	150 02 30	22089.3	24156.2	13.73
Poplar Ridge	40 22 14.30	74 42 10.75	302 51 53 338 46 08	Disboro'	123 01 40	25453.2	27834.8	15.82
				Stony Hill.....	158 51 06	29925.0	32725.1	18.59
Lawrenceville, (signal).....	40 18 05.01	74 43 48.71	284 28 46 196 43 42	Disboro'	104 39 25	24471.4	26761.2	15.21
				Poplar Ridge.....	16 44 45	8028.2	8779.4	4.99
Hezel's Farm, (2).....	40 18 02.77	74 40 08.69	159 38 13 90 47 01	Poplar Ridge.....	339 36 54	8275.0	9049.3	5.14
				Lawrenceville, (signal).....	270 44 39	5196.0	5682.2	3.23
Lawrenceville, (spire).....	40 17 51.00	74 43 25.25	127 58 13 265 30 40	Lawrenceville, (signal).....	307 57 58	702.6	768.4	0.44
				Hezel's Farm, (2).....	85 32 47	4656.0	5091.7	2.89
Mepleton, (2)	40 21 08.62	74 36 23.83	42 49 17 103 55 58	Hezel's Farm, (2).....	222 46 51	7811.7	8542.7	4.85
				Poplar Ridge.....	283 52 13	8431.8	9220.8	5.24

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Cold Soil, (2).....	40 20 37.84	74 42 13.90	263 57 55 181 25 40	Princeton Seminary..... Poplar Ridge.....	88 59 38 1 25 42	3766.5 2976.0	4118.9 3254.5	2.34 1.85
Cranberry Steeple.....	40 18 23.68	74 30 48.32	113 53 15 322 01 42	Poplar Ridge..... Disboro'.....	293 45 53 142 04 06	17606.2 8535.4	19253.6 9334.1	10.94 5.30
Mount Canoe.....	40 19 37.76	74 51 19.98	284 34 45 249 15 13	Disboro'..... Mount Rose.....	104 50 25 69 20 33	35502.7 12457.7	38824.7 13623.4	22.06 7.74
Pennington Seminary.....	40 19 35.36	74 47 18.30	233 00 47 90 46 03	Mount Rose..... Mount Canoe.....	53 03 31 270 43 26	7447.2 5705.2	8144.0 6239.0	4.63 3.54
Arney.....	40 00 25.66	74 41 53.02	177 31 34 145 38 09	Mount Rose..... Newtown.....	357 30 53 325 38 09	39973.5 32712.8	43713.8 35773.7	24.84 20.33
NEW JERSEY AND PENNSYLVANIA.								
<i>Delaware River, from Trenton to Philadelphia.</i>								
Trenton, (Presbyterian ch. spire.)	40 13 10.23	74 45 29.54	305 32 49 5 03 12	Stony Hill,..... Mount Holly.....	125 39 52 185 02 14	19103.1 24275.5	20890.6 26546.9	11.87 15.08
Centreville.....	40 09 41.77	74 49 58.70	346 33 01 224 41 45	Mount Holly..... Trenton, (Presbyterian church)	166 34 56 44 44 36	18252.5 9047.8	19960.4 9894.4	11.34 5.62
Stackhouse.....	40 09 56.38	74 54 42.02	178 13 03 313 56 49	Newtown..... Arney.....	358 12 55 134 05 04	9384.1 25330.7	10262.2 27700.9	5.83 15.74
Wynkoop.....	40 12 56.90	74 58 25.74	232 38 12 316 26 07	Newtown..... Stack-house,.....	52 40 29 136 28 31	6284.6 7680.9	6872.7 8399.6	3.91 4.77

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

S. Doc. 3.

291

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
Attleboro' Academy, (cupola).	0 10 50.63	74 54 58.27	0 41 16	Newtown	0 41 19	Metres. 7706.6	Yards. 8427.7	Miles. 4.79
Thomas	40 13 11.92	74 58 00.17	128 27 20	Wynkoop	308 25 06	6263.6	6849.7	3.89
Watson	40 12 11.77	74 55 08.65	232 39 23	Newtown	52 41 23	5523.0	6039.8	3.43
Martingale	40 14 35.10	74 56 37.62	315 21 07	Attleboro' Academy Cupola	135 23 04	6122.6	6695.5	3.80
Oxford	40 10 21.42	74 53 22.14	106 38 46	Wynkoop	286 36 39	4863.1	5318.1	3.02
Briggs	40 12 22.19	74 53 17.54	183 42 55	Newtown	3 43 04	5214.9	5702.8	3.24
Pleasantville	40 09 48.27	74 58 44.83	252 11 19	Attleboro' Academy Cupola	72 12 26	2562.5	2802.3	1.59
Attleboro' Academy, (signal).	40 10 50.68	74 54 58.39	341 14 55	Wynkoop	161 15 59	7309.1	7993.0	4.54
Churchville	40 11 34.07	75 00 58.93	165 47 33	Attleboro' Academy Cupola	345 46 33	8878.5	9709.3	5.52
Vancleve	40 09 07.75	75 02 42.31	111 37 55	Wynkoop	291 36 53	2446.2	2675.1	1.52
Miles	40 11 14.06	75 02 53.70	154 53 43	Attleboro' Academy Cupola	334 52 40	5143.2	5624.5	3.20
			40 10 10	Wynkoop	220 09 05	3523.3	3853.0	2.19
			184 26 14	Attleboro' Academy Signal	4 26 26	5834.5	6330.4	3.63
			250 13 16	Wynkoop	70 15 44	5692.6	6225.3	3.54
			128 27 39	Watson	308 25 25	6261.0	6846.8	3.89
			174 26 30	Attleboro' Academy Signal	354 26 16	2512.6	2747.7	1.56
			278 53 05	Pleasantville	98 57 02	8632.6	9440.4	5.36
			315 47 28	Attleboro' Academy Cupola	135 48 55	4550.7	4976.5	2.83
			253 50 12	Churchville	73 55 11	11428.5	12497.9	7.10
			208 27 06	Vancleve	28 28 13	5133.2	5613.5	3.19
			257 10 49	Churchville	77 12 03	2784.4	3044.9	1.73
			356 02 29	Vancleve	176 02 36	3904.8	4270.2	2.43

Name of station,	Latitude.		Longitude.		Azimuth.		To station—	Back azimuth.			Distance.	Distance.	Distance.
	°	' "	°	' "	°	' "		°	' "	Metres.	Yards.	Miles.	
Falsington	40	11 50.61	74	48 24.58	293	41 49	Stony Hill.....	113	50 45	21500.5	23512.3	13.36	
					254	42 22	Mount Holly.....	174	43 17	21819.3	23860.9	13.56	
Claybanks.....	40	07 11.49	74	47 33.41	194	49 30	Trenton Presbyterian Church.	14	50 50	11445.3	12516.2	7.11	
					143	26 23	Centreville.....	323	24 46	5771.3	6311.3	3.59	
White Hill	40	08 19.49	74	43 33.66	163	00 33	Trenton Presbyterian Church.	342	59 23	9376.1	10253.4	5.83	
					105	35 47	Centreville.....	285	31 39	9459.2	10344.3	5.88	
Whitehorse.....	40	11 10.70	74	42 07.51	127	40 06	Trenton Presbyterian Church.	307	37 56	6034.1	6598.7	3.75	
					46	17 56	Claybanks.....	226	14 27	10672.9	11671.6	6.63	
Bordentown, (Bonaparte's Observatory.)	40	09 17.57	74	42 24.14	62	03 04	Claybanks.....	241	59 48	8289.2	9064.8	5.15	
					94	00 35	Centreville.....	273	55 42	10782.1	11791.0	6.70	
Turkey Hill.....	40	09 49.10	74	46 09.73	22	10 44	Claybanks.....	202	09 50	5248.6	5739.7	3.26	
					87	38 02	Centreville.....	267	35 34	5422.6	5930.0	3.37	
Bristol, (Kinzey's Hotel)....	40	05 37.68	74	51 03.32	221	51 04	Turkey Hill.....	41	54 13	10413.8	11388.2	6.47	
					239	47 10	Claybanks.....	59	49 25	5752.6	6290.9	3.57	
Bordentown, (flag-pole)	40	03 49.95	74	42 29.99	98	36 18	Centreville.....	278	31 29	10738.2	11743.0	6.67	
					67	07 01	Claybanks.....	247	03 45	7797.5	8527.1	4.84	
King.....	40	01 18.05	74	56 10.10	185	26 35	Stack-house.....	6	26 32	16120.8	17629.2	10.01	
					277	36 55	Mount Holly.....	99	41 42	13239.1	14477.9	8.23	
China College.....	40	04 45.91	74	53 43.47	171	45 57	Stack-house.....	351	45 19	9674.3	10579.5	6.01	
					28	28 37	King.....	208	27 03	7291.0	7973.2	4.53	
Woodside.....	40	03 44.52	74	49 14.43	106	34 02	China College.....	286	31 09	6649.6	7271.8	4.13	
					145	57 16	Stack-house.....	325	53 45	13845.0	15140.5	8.60	

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' '	Metres.	Yards.	Miles.
Belmont	40 08 19.48	74 56 28.85	318 23 56	Mount Holly	138 30 02	20331.0	22233.4	12.63
			358 02 24	King	178 02 36	13004.5	14221.3	8.03
Andalusia	40 04 26.40	74 57 03.15	299 14 49	Mount Holly	119 21 17	16403.0	17937.8	10.19
			347 46 46	King	167 47 20	5943.7	6500.0	3.69
Rosehill	40 04 07.78	74 58 41.08	325 37 29	King	145 39 01	6340.9	6934.2	3.94
			294 04 45	Mount Holly	114 12 22	18220.1	19924.9	11.32
Cowperthwaite	40 03 10.10	74 59 06.88	309 29 23	King	129 31 22	5431.6	5939.8	3.38
			198 57 29	Rosehill	18 57 46	1880.9	2056.9	1.17
Clapier	40 01 09.22	75 09 48.35	201 29 03	Willow Grove	21 31 28	14577.0	15941.0	9.06
			273 18 31	Mount Holly	93 33 11	32515.3	35557.8	20.20
Chestnut Hill, (flag-staff)	40 04 32.94	75 12 08.12	332 11 09	Clapier	152 12 39	7102.8	7767.4	4.41
			229 53 21	Willow Grove	49 57 16	11306.2	12364.1	7.02
Chew	39 48 13.89	75 09 42.28	179 39 18	Clapier	359 39 14	23910.8	26148.1	14.86
			272 39 17	Pine Hill	92 45 57	14902.2	16296.6	9.26
Davis	39 55 36.96	75 17 56.20	228 26 29	Clapier	48 31 43	15459.3	16905.8	9.61
			319 17 28	Chew	139 22 45	18013.4	19698.9	11.19
Vicinity of Philadelphia.								
Girard College	39 58 23.53	75 09 54.09	322 06 55	Pine Hill	142 13 42	24697.6	27008.5	15.34
			264 20 14	Mount Holly	84 34 57	32756.4	35821.4	20.35
Christ Church	39 56 59.66	75 08 20.27	259 10 04	Mount Holly	79 23 47	30923.4	33816.9	19.21
			322 34 55	Pine Hill	142 40 44	21253.7	23280.7	13.23

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
St. Paul's Church, (spire) . . .	39 57 44.56	75 08 11.62	160 01 36 116 20 43	Clapier Girard College	340 00 34 296 19 37	6715.6 2712.4	7344.0 2966.2	4.17 1.69
Arch Street Church	39 57 09.46	75 09 06.38	77 16 05 2 57 34	Davis Chew	257 10 24 182 57 11	12896.9 16538.7	14103.7 18086.2	8.01 10.28
St. Peter's Church, (Phila.) . .	39 56 32.23	75 08 33.89	168 19 13 150 59 50	Clapier Girard College	348 18 24 330 58 58	8720.8 3924.1	9536.8 4291.3	5.42 2.44
State House Spire, (Phila.) . .	39 56 52.61	75 08 41.90	321 08 18 5 07 46	Pine Hill Chew	141 14 20 185 07 07	21434.5 16061.1	23440.1 17563.9	13.33 6.62
Beck's Shot Tower,	39 57 20.38	75 10 12.14	258 48 15 192 23 49	Fishcove Girard College	78 52 31 12 24 01	9637.8 1995.4	10539.6 2182.1	5.99 1.24
Eight-square Spire	39 55 45.96	75 08 40.40	160 02 14 170 45 13	Girard College Clapier	340 01 27 350 44 29	5128.7 10069.5	5608.6 11011.7	3.19 6.26
Sparks' Shot Tower	39 56 02.18	75 08 28.52	168 41 42 155 02 10	Clapier Girard College	348 40 51 335 01 15	9656.0 4809.8	10559.5 5259.9	6.00 2.99
Factory	39 58 37.58	75 08 23.77	156 47 13 78 36 57	Clapier Girard College	336 46 19 258 35 59	5083.7 2185.9	5564.9 2390.4	3.16 1.36
Monument Cemetery	39 58 51.24	75 09 08.62	51 39 28 167 30 54	Girard College Clapier	231 38 59 347 30 28	1371.8 4358.3	1500.2 4763.1	0.85 2.71
Commissioners' Hall, (Ken- sington.)	39 58 16.30	75 07 47.16	94 16 19 151 40 55	Girard College Clapier	274 14 57 331 39 37	3019.9 6058.1	3302.5 6225.0	1.83 3.76
Wood's Point,	39 57 25.27	75 05 19.23	137 16 29 105 26 23	Clapier Girard College	317 13 23 285 23 39	9405.2 6765.2	10285.3 7398.2	5.84 4.20

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
						Metres.	Yards.	Miles.
Fishcove, (Hatchis)	39 58 20.87	75 03 33.67	63 48 15 120 19 34	Christ Church Clapier	249 45 01 300 15 24	7247.4 10292.4	7925.5 11245.5	4.59 6.39
Washington Hunter, (1)	40 00 52.51	74 58 48.73	91 56 45 73 49 55	Clapier	271 49 31 253 42 58	15649.6 16436.7	17113.9 17974.7	9.72 10.21
Washington Hunter, (2)	40 00 52.73	74 58 57.20	61 45 49 91 56 35	Christ Church Clapier	241 39 46 271 49 36	15169.3 15449.0	16588.7 16904.6	9.43 9.60
Rancocas	40 02 33.10	74 58 20.84	136 19 03 12 02 30	Cowperthwaite	316 18 33 192 02 12	1578.8 3172.4	1726.5 3469.3	0.98 1.97
Morris Hill	39 59 21.78	75 02 17.26	107 15 05 80 33 26	Clapier	287 10 07 260 33 40	11200.3 10935.2	12248.3 12013.1	6.96 6.82
Camden, (church spire)	39 56 41.06	75 07 00.19	154 15 44 127 28 27	Clapier	334 13 56 307 26 35	9182.0 5198.6	10041.2 5685.0	5.71 3.23
Rockwell's House	39 56 37.16	75 12 06.02	223 38 39 255 13 00	Girard College	43 40 04 75 18 29	4536.0 12573.0	4960.4 13749.5	2.82 7.81
Germanatown Spire	40 01 02.16	75 10 48.10	295 43 41 261 15 05	Fishcove	115 48 20 81 15 43	11442.2 1433.2	12512.8 1567.3	7.11 0.89
Lukens	40 06 32.18	75 02 10.30	353 10 57 298 48 08	Pine Hill	173 12 49 118 57 54	34820.7 24647.1	38078.9 26953.3	21.63 15.31
Cherry Tree Signal	40 02 41.03	75 07 01.52	328 25 08 10 03 53	Fishcove	148 27 22 190 03 02	9415.7 10692.3	10296.7 11692.8	5.85 6.64
Bridensburg Foundry, (signal)	40 00 10.16	75 03 27.41	101 26 08 70 19 08	Clapier	281 22 03 250 14 59	9214.9 9742.9	10077.1 10654.5	5.73 6.05

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Bridesburg Arsenal, (flag-staff.)	40 00 26.24	75 03 40.16	66 56 05 98 39 50	Girard College..... Clapier	246 52 05 278 35 53	9642.8 8831.0	10545.1 9657.3	5.99 5.49
George Knowles.....	40 01 14.68	75 01 34.00	53 30 57 16 25 55	Bridesburg Foundry..... Morris' Hill	233 29 52 196 25 27	3345.7 3631.7	3653.8 3971.5	2.08 2.26
Five Mile Point.....	39 59 01.43	75 04 10.34	28 53 27 81 53 25	Wood's Point..... Girard College.....	208 52 29 261 49 44	3386.7 8239.2	3703.6 9010.1	2.10 5.12
Clark	40 00 12.41	75 13 57.97	270 08 41 317 26 21	Mount Holly..... Pine Hill.....	90 26 01 137 35 47	38381.6 31001.4	41972.9 33902.2	23.85 19.26
Moorestown Spire.....	39 57 42.27	74 56 42.09	252 08 49 100 45 44	Mount Holly..... Clark	72 15 03 280 34 39	14511.8 25007.7	15869.7 27347.7	9.02 15.54
Evesham	39 56 00.45	74 53 20.81	112 12 18 230 00 37	Clapier	292 01 43 50 04 42	25293.2 11798.4	27659.9 12902.4	15.72 7.33
Haddonfield	39 52 50.37	75 02 03.80	237 52 03 336 40 30	Mount Holly..... Pine Hill.....	58 01 44 156 42 17	25322.6 10051.8	27692.0 10992.4	15.73 6.25
Gibbsboro'	39 50 17.57	74 56 39.88	121 29 57 217 08 56	Haddonfield	301 26 30 37 15 08	9026.4 22787.3	9871.0 24919.5	5.61 14.16
Mount Hope	39 52 24.50	75 26 08.66	202 41 53 288 09 11	Yard	22 44 00 108 19 43	11943.4 24691.1	13060.9 27001.3	7.42 15.34
Lippencott, (2)	39 43 16.92	75 18 30.21	182 01 36 233 51 57	Davis..... Chew	2 01 57 53 57 35	22836.4 15548.4	24973.2 17003.3	14.19 9.66
Robbins, (2).....	39 44 31.29	75 19 42.75	187 00 20 244 16 19	Davis..... Chew	7 01 28 64 22 43	20684.1 15852.5	22619.3 17335.8	12.85 9.85

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lazaretto, (1).....	39 51 33.96	75 17 52.23	11 23 00 297 51 48	Robbins, (2)..... Chew	191 21 49 117 57 02	13296.8 13182.2	14541.0 14415.7	8.26 8.19
Lazaretto Flag-staff.....	39 51 32.89	75 17 42.70	12 22 09 298 12 18	Robbins, (2)..... Chew.....	192 20 53 118 17 26	13311.3 12966.8	14556.8 14180.1	8.27 8.06
Leiperville	39 52 22.50	75 19 15.52	2 31 40 299 18 35	Robbins, (2)..... Chew.....	182 31 23 119 24 43	14546.9 15637.8	15908.1 17101.0	9.04 9.72
Chester Catholic Church....	39 51 02.20	75 21 19.52	349 09 01 287 19 19	Robbins, (2)..... Chew	169 10 03 107 26 45	12275.4 17372.4	13424.0 18998.0	7.63 10.79
Thurlow	39 49 38.12	75 22 52.54	243 23 25 334 26 25	Lazaretto, (1)..... Robbins, (2).....	63 26 37 154 28 27	7983.1 10488.4	8730.1 11469.8	4.96 6.52
Lamoken	39 50 36.87	75 22 13.66	232 24 36 342 17 36	Leiperville	52 26 30 162 19 13	5342.1 11835.0	5842.0 12942.4	3.32 7.35
<i>Delaware River..</i>								
Thompson's Point	39 50 31.83	75 18 04.50	91 31 28 153 41 24	Lamoken	271 28 48 333 40 38	5925.3 3807.5	6479.7 4163.8	3.68 2.37
Man Island.....	39 50 19.67	75 19 08.59	96 53 34 177 30 33	Lamoken	276 51 36 357 30 29	4431.7 3791.8	4846.4 4146.6	2.75 2.36
Ridley Creek.....	39 51 08.81	75 20 05.20	291 39 59 207 27 03	Thompson's Point..... Leiperville	111 41 15 27 27 34	3087.5 2560.9	3376.4 2800.5	1.92 1.59
Opposite Chester	39 49 40.27	75 20 20.24	187 27 28 234 29 55	Ridley Creek..... Man Island.....	7 27 38 54 30 41	2753.8 2092.4	3011.5 2288.2	1.71 1.30

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

298

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Crab Creek	39 50 33.40	75 17 20.33	156 52 34 104 19 25	Lazaretto (1)..... Ridley Creek	336 52 14 284 17 39	1930.2 4044.5	2110.8 4422.9	1.20 3.51
Isaac	39 50 44.84	75 15 23.37	84 39 28 113 11 15	Crab Creek	264 38 13	2792.6	3053.9	1.74
				Lazaretto (1)	293 09 39	3848.8	4208.9	2.39
Tinicum	39 51 39.24	75 15 44.45	343 21 57 49 37 57	Isaac	163 22 11	1750.7	1914.5	1.09
				Crab Creek	229 36 56	2991.6	3271.5	1.86
Billingsport	39 51 00.24	75 14 15.88	73 31 22 119 44 54	Isaac	253 30 39	1673.0	1829.5	1.04
				Tinicum	299 43 57	2424.6	2651.5	1.51
Hog Island	39 51 57.79	75 14 00.14	41 20 02 77 00 45	Isaac	221 19 09	2995.7	3276.0	1.86
				Tinicum	256 59 38	2544.2	2782.3	1.58
Mathew	39 51 16.54	75 12 23.33	118 56 45 79 21 53	Hog Island	298 55 43	2629.1	2875.1	1.63
				Billingsport	259 20 41	2722.0	2976.7	1.69
Fort Mifflin	39 52 28.57	75 12 25.13	358 53 49 67 12 31	Mathew	178 53 50	2221.5	2429.4	1.33
				Hog Island	247 11 39	2449.1	2678.3	1.52
Fort Mifflin, (flag-staff)	39 52 28.57	75 12 25.88	358 25 51 67 02 37	Mathew	178 25 53	2222.0	2429.9	1.33
				Hog Island	247 01 37	2432.4	2660.0	1.51
Woodbury Creek	39 51 50.06	75 11 33.29	49 00 49 133 57 31	Mathew	229 00 18	1575.6	1723.0	0.98
				Fort Mifflin	313 56 58	1711.1	1871.2	1.06
South League Island	39 53 06.05	75 11 09.20	13 43 23 57 21 21	Woodbury Creek	193 43 08	2412.4	2638.1	1.50
				Fort Mifflin	237 20 32	2142.4	2342.9	1.33
Red Bank	39 52 23.26	75 10 53.98	164 40 06 94 19 53	South League Island	344 39 56	1368.3	1496.3	0.85
				Fort Mifflin	274 18 55	2172.1	2375.4	1.35

S. Doc. 3.

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Red Bank, (flag-staff).....	39 52 17.35	75 11 01.59	99 54 01 46 01 15	Fort Mifflin	279 53 07	2014.9	2203.4	1.25
Schuylkill	39 53 32.85	75 11 22.86	338 33 44 18 52 26	South League Island.....	158 33 53	888.0	971.1	0.55
Eagle Point	39 52 39.28	75 09 41.21	111 33 43 85 10 00	Fort Mifflin	198 51 53	4441.3	4856.9	2.76
North League Island	39 53 11.77	75 09 38.35	50 13 17 85 19 55	South League Island.....	291 32 48	2247.4	2457.7	1.40
Big Timber Creek.....	39 52 42.68	75 07 45.54	87 49 27 108 31 04	Fort Mifflin	265 08 20	3908.3	4274.0	2.43
No. 3	39 53 44.62	75 08 27.90	332 12 40 40 50 27	Red Bank.....	230 12 29	2338.1	2556.9	1.45
Gloucester Point.....	39 53 46.11	75 07 27.36	88 10 37 12 26 45	South League Island.....	265 18 56	2165.5	2368.1	1.35
Fish Club, (flag-staff).....	39 53 13.54	75 07 24.32	122 20 46 28 03 47	Eagle Point	267 48 12	2750.5	3007.9	1.71
Powder Wharf.....	39 54 10.47	75 07 43.73	52 46 35 332 38 33	North League Island.....	288 29 52	2826.6	3091.1	1.76
Mickle.....	39 54 37.24	75 07 02.97	51 11 34 20 10 30	Big Timber Creek.....	152 13 07	2159.3	2361.4	1.34
No. 1	39 54 40.81	75 07 51.43	275 26 58 348 56 24	Eagle Point	220 49 33	2663.4	2912.6	1.66
				No. 3.....	268 09 58	1438.8	1573.4	0.90
				Big Timber Creek.....	192 26 33	2003.3	2190.8	1.25
				No. 3.....	302 20 05	1791.8	1959.5	1.11
				Big Timber Creek.....	208 03 32	1078.6	1179.5	0.67
				No. 3.....	232 46 08	1317.8	1441.1	0.82
				Gloucester Point.....	152 38 45	845.9	925.1	0.53
				No. 3.....	231 10 40	2588.9	2831.2	1.61
				Gloucester Point.....	290 10 14	1679.8	1837.0	1.04
				Mickle.....	95 27 29	1156.0	1264.2	0.72
				Powder Wharf.....	168 56 29	952.7	1041.9	0.59

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Pennsylvania. Sketch B, No. 3.

200

S. Doc. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Kaighn's Point.....	39 55 42.89	75 07 33.04	12 51 08 340 34 27	No. 1..... Mickle.....	192 50 56 160 34 46	1963.8 2146.7	2147.6 2347.6	1.22 1.33
Navy Yard, (Philadelphia)...	39 55 46.97	75 08 14.52	344 57 21 277 15 52	No. 1..... Kaighn's Point.....	164 57 37 97 16 19	2112.7 992.9	2310.4 1085.8	1.31 0.62
Smith's Island	39 56 17.99	75 07 56.31	332 57 06 24 19 02	Kaighn's Point..... Navy Yard	152 57 21 204 18 50	1215.3 1049.9	1329.0 1148.1	0.75 0.65
Philadelphia Walnut Street Ferry.	39 56 34.08	75 07 27.22	5 00 14 54 18 53	Kaighn's Point..... Smith's Island	185 00 10 234 18 34	1584.5 850.4	1732.8 930.0	0.99 0.53
Cooper's Point.....	39 57 12.58	75 07 22.69	73 40 19 5 09 59	Christ Church	253 39 43 185 09 56	1422.3 1192.2	1555.4 1303.8	0.88 0.74
Screw Dock.....	39 57 46.92	75 07 36.53	342 46 24 26 56 00	Cooper's Point..... Market Street	162 46 33 206 55 38	1108.9 1762.9	1212.7 1927.9	0.69 1.10
Richmond	39 58 15.62	75 06 39.93	56 36 22 27 34 26	Screw Dock..... Cooper's Point.....	236 35 46 207 33 59	1608.6 2193.0	1759.1 2398.2	1.00 1.36
Philadelphia, (Market Street)	39 56 55.96	75 08 10.17	245 32 18 303 29 34	Cooper's Point..... Walnut Street Ferry	65 32 49 123 30 02	1238.0 1222.7	1353.8 1337.1	0.77 0.76
<i>Delaware River, S. of Chester.</i>								
Chester	39 50 33.04	75 21 03.33	231 23 35 278 35 36	Ridley Creek	51 24 12 98 36 44	1767.9 2758.7	1933.3 3016.8	1.10 1.72
Tonkin's Island East.....	39 49 11.40	75 21 40.94	245 07 00 199 33 27	Opposite Chester..... Chester	65 07 52 19 33 51	2115.4 2671.5	2313.4 2921.5	1.31 1.66

United States Coast Survey.—Geographical Positions.

Section II.—New Jersey and Delaware. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Tonkin's Island West.....	39 48 48.96	75 22 31.28	161 33 19 239 57 03	Thurlow Tonkin's Island East.....	341 33 05 59 57 35	1598.5 1382.6	1748.1 1512.0	0.99 0.86
Marcus Hook.....	39 48 38.24	75 24 24.97	229 57 40 255 17 54	Thurlow Tonkin's Island East.....	49 58 39 75 19 37	2871.1 4033.0	3139.8 4410.4	1.79 2.51
Opposite Marcus Hook.....	39 47 39.07	75 24 02.17	163 27 07 204 16 22	Marcus Hook..... Thurlow	343 26 52 24 17 08	1903.9 4027.7	2082.0 4404.6	1.18 2.50
Naaman's Creek	39 48 02.32	75 26 13.52	246 46 07 282 54 48	Marcus Hook..... Opposite Marcus Hook	66 47 16 102 56 17	2809.5 3205.8	3072.4 3505.8	1.75 1.99
Old Man Creek	39 47 01.84	75 25 33.11	208 35 27 242 01 43	Marcus Hook..... Opposite Marcus Hook	28 36 11 62 02 43	3386.5 2449.5	3703.4 2678.7	2.10 1.52
Lodge	39 47 04.15	75 27 51.56	271 14 17 232 25 37	Old Man Creek	91 15 45 52 26 40	3294.8 2942.4	3603.1 3217.7	2.05 1.83
Old Man Point.....	39 45 37.24	75 27 21.92	165 15 32 199 59 00	Lodge Naaman's Creek	345 15 13 19 59 44	2771.4 4760.8	3030.7 5206.3	1.72 2.96
Dupont's Wharf.....	39 45 01.98	75 29 17.26	248 21 57 208 24 23	Old Man Point..... Lodge	68 23 58 28 26 05	2953.0 4284.4	3229.3 4685.3	1.84 2.66
Penn Grove	39 43 59.74	75 28 19.10	144 11 57 204 20 27	Dupont's Wharf..... Old Man Point.....	324 11 20 24 21 54	2366.7 3301.2	2588.2 3610.1	1.47 2.05
Christine Light-house, or Wilmington Light-house.	39 43 15.25	75 30 55.69	249 47 11 215 26 39	Penn Grove Dupont's Wharf.....	69 48 52 35 27 42	3973.2 4040.5	4345.0 4418.6	2.47 2.51
Quarry Wharf	39 46 16.71	75 28 21.68	359 09 45 29 51 13	Penn Grove Dupont's Wharf.....	179 09 47 209 50 38	4224.6 2657.3	4619.9 2905.9	2.62 1.65

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Black Horse	39 54 45.42	75 25 06.62	298 42 41 336 01 26	Chew..... Lippencott (2).....	118 52 33 156 05 40	25068.6	27414.3	15.58
						23231.5	25405.3	14.44
West	39 45 36.73	75 12 00.61	132 13 48 214 10 04	Black Horse..... Chew.....	312 05 24 34 11 33	25210.0	27568.9	15.66
						5858.6	6406.8	3.64
Caffery	39 47 28.44	75 12 59.73	128 01 01 253 21 58	Black Horse..... Chew.....	307 53 15 73 24 05	21912.1	23962.4	13.61
						4901.4	5360.0	3.05
Acton	39 38 08.61	75 22 45.32	169 37 36 212 34 12	Mount Hope..... Lippencott (2).....	349 35 26 32 36 55	26834.8	29345.7	16.67
						11284.9	12340.8	7.01
Grand View	39 42 39.49	75 42 03.43	286 44 24 305 44 50	Acton..... Burden	106 56 44 125 57 17	28837.5	31535.8	17.92
						34426.5	37647.8	21.39
Wilmington	39 44 55.82	75 33 35.61	308 58 05 70 53 09	Acton..... Grand View	129 05 00 250 47 44	19943.1	21852.9	12.42
						12802.3	14000.2	7.95
Shellpot	39 45 57.52	75 30 00.89	324 17 57 71 16 44	Acton..... Meeting-house Hill	144 22 35 251 08 37	17797.9	19463.2	11.06
						18608.6	20349.8	11.56
Iron Hill.....	39 38 17.28	75 44 48.40	350 58 54 76 57 39	Buck (2)..... Principio.....	170 59 40 256 47 59	11044.2	12077.6	6.86
						22257.5	24340.1	13.83
Barker	39 26 16.76	75 21 45.94	124 04 05 173 37 25	Iron Hill..... Burden	303 49 25 353 36 56	39793.3	43516.8	24.73
						10209.6	11164.9	6.34
Fort Delaware	39 35 18.79	75 33 49.20	109 21 06 139 07 22	Iron Hill..... Grand View	289 14 05 319 01 58	16658.9	18217.7	10.35
						17986.5	19669.5	11.18
Swedesboro' Spire	39 44 58.94	75 18 07.32	180 46 08 243 22 42	Davis..... Chew	0 46 15 63 28 06	19677.6	21518.8	12.23
						13437.5	14694.9	8.35

United States Coast Survey.—Geographical Positions.

Section II.—New Jersey and Delaware.

Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Scull, (1).....	39 43 30.01	75 20 22.73	93 02 59 103 20 27	Wilmington..... Shellpot.....	277 54 32 288 14 17	19061.8 14495.8	20845.4 15852.2	11.84 9.01
Allen.....	39 41 14.14	75 22 28.26	4 03 53 113 20 00	Acton..... Wilmington.....	184 03 42 293 12 53	5735.6 17301.3	6272.5 18920.2	3.57 10.75
Scull, (2).....	39 40 56.57	75 20 32.89	31 22 02 101 09 23	Acton..... Allen.....	211 20 37 281 08 15	6065.3 2801.5	6632.8 3063.6	3.77 1.74
Big Mannington Hill.....	39 36 54.09	75 21 21.79	139 05 27 168 49 43	Acton..... Allen.....	319 04 33 348 49 00	3041.1 8174.3	2325.7 8939.2	1.89 5.08
Reeves.....	39 39 03.38	75 22 46.20	125 08 51 141 00 22	Wilmington..... Shellpot.....	305 01 56 320 55 44	18906.4 16441.4	20675.5 17979.8	11.75 10.22
Ellet.....	39 38 19.55	75 23 37.65	130 38 51 147 06 48	Wilmington..... Shellpot.....	310 32 29 327 02 43	18780.0 16824.9	20537.3 18399.2	11.67 10.45
Sawyer.....	39 42 02.84	75 33 29.56	95 28 12 178 28 06	Grandview..... Wilmington.....	275 22 44 358 28 02	12296.0 5366.0	13446.5 5868.1	7.54 3.33
Baar.....	39 40 45.33	75 35 01.35	109 20 32 194 48 01	Grandview..... Wilmington.....	289 16 02 14 48 56	10655.8 7989.7	11652.9 8737.3	6.62 4.96
New Castle, (spire of Episcopal church.)	39 39 35.71	75 33 27.34	114 48 33 178 52 54	Grandview..... Wilmington.....	294 43 04 358 52 49	13538.8 9874.6	14805.6 10798.6	8.41 6.14
Chestnut Hill.....	39 39 00.45	75 45 51.27	218 45 41 237 55 06	Grandview..... Wilmington.....	38 48 06 58 02 56	8667.5 20669.9	9478.5 12604.0	5.39 12.84
Salem Spire.....	39 34 25.42	75 27 37.98	108 06 41 126 31 12	Chestnut Hill..... Grandview.....	287 55 04 306 22 00	27422.5 25650.9	29988.4 25051.0	17.04 15.93

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
McMullen.....	39 37 36.87	75 37 47.22	102 37 36 146 49 37	Chestnut Hill..... Grandview	282 32 27 326 46 53	11825.5 11153.2	12932.0 12196.8	7.35 6.93
Gray's Hill.....	39 36 44.50	75 47 32.43	233 48 08 324 55 51	Iron Hill..... Buck, (2).....	53 49 52 144 58 13	4846.8 9829.4	5300.3 10749.1	3.01 6.11
Riggs' Hill.....	39 35 30.27	75 54 23.28	249 21 32 289 26 50	Iron Hill..... Buck, (2).....	69 27 38 109 33 51	14646.7 16488.8	16017.2 18031.7	9.10 10.25
Gravelly Hill.....	39 38 35.02	75 57 31.38	271 39 03 321 45 44	Iron Hill..... Riggs' Hill.....	91 47 11 141 47 44	18199.4 7251.7	19902.3 7930.2	11.31 4.51
Bohemia Manor.....	39 28 46.70	75 46 24.61	137 28 23 173 44 20	Riggs' Hill..... Gray's Hill.....	317 23 18 353 43 37	16892.0 14818.3	18472.6 16204.9	10.50 9.21
Ash.....	39 38 02.71	75 47 12.60	65 26 48 93 54 58	Riggs' Hill..... Gravelly Hill.....	245 22 13 273 48 23	11297.2 14787.5	12354.3 16171.2	7.02 9.19
Head of Christine.....	39 41 44.37	75 47 20.85	1 42 36 41 09 15	Gray's Hill..... Riggs' Hill.....	181 42 29 221 04 45	9251.4 15313.7	10117.1 16746.6	5.74 9.52
Shickerville.....	39 43 52.24	75 47 08.25	342 06 12 2 30 04	Iron Hill..... Gray's Hill.....	162 07 41 182 29 49	10853.6 13203.3	11869.2 14438.2	6.74 8.20
Missimer	39 44 56.00	75 47 44.46	341 08 47 297 22 02	Iron Hill..... Grandview	161 10 39 117 25 40	12991.4 9147.0	14207.0 10002.9	8.07 5.68
Maulden's Mountain.....	39 29 12.01	75 59 07.83	255 03 38 174 16 38	Buck, (2)..... Principio.....	75 13 27 354 16 06	23030.2 11822.6	25185.1 12928.9	14.31 7.35
Egg Hill.....	39 39 30.21	75 53 41.21	50 52 53 22 15 49	Principio..... Maulden's Mountain.....	230 48 53 202 12 21	11563.4 20595.8	12645.4 22523.0	7.18 12.80

United States Coast Survey.—Geographical Positions. Section II.—New Jersey and Delaware. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
2 Buck, (1).....	39 32 29.31	75 43 23.39	169 18 05 74 59 13	Iron Hill..... Maulden's Mountain.....	349 17 11 254 49 12	10920.5 23364.6	11942.3 25550.8	6.79 14.52
Church Landing Point.....	39 39 36.75	75 31 00.87	89 28 06 159 28 40	New Castle Spire..... Wilmington.....	269 26 32 339 27 01	3495.4 10507.1	3822.5 11490.3	2.17 6.53
Wilmington Town Hall.....	39 44 26.56	75 32 42.43	344 51 03 125 29 00	Church Landing Point..... Wilmington.....	164 51 38 305 28 26	9259.4 1554.0	10125.8 1699.4	5.75 0.97
Kimsey.....	39 38 03.11	75 33 02.74	225 11 27 168 23 46	Church Landing Point..... New Castle Spire.....	45 12 45 348 23 30	4100.1 2915.3	4483.8 3188.1	2.55 1.81
Great Creek.....	39 38 33.02	75 35 17.56	286 00 10 233 38 45	Kimsey..... New Castle Spire.....	106 01 36 53 39 55	3344.2 3261.9	3657.1 3567.1	2.08 2.03
Red Lion.....	39 35 50.40	75 36 24.25	229 35 25 197 36 05	Kimsey..... Great Creek.....	49 37 34 17 36 48	6310.3 5258.1	6900.7 5750.1	3.92 3.27
Finn's Point.....	39 35 58.11	75 32 45 92	12 13 38 347 35 41	Port Penn..... Elsinborough Point.....	192 12 48 167 36 20	8862.7 6832.1	9692.0 7471.4	5.51 4.25
Delaware City Spire.....	39 34 38.14	75 35 17.59	144 29 21 235 45 34	Red Lion..... Finn's Point.....	324 28 38 55 47 10	2737.8 4386.7	2994.0 4797.2	1.70 2.73
Penn's Neck.....	39 35 38.05	75 32 16.88	132 10 36 93 43 01	Finn's Point..... Red Lion.....	312 10 17 273 40 23	923.7 5913.7	1010.1 6467.1	0.57 3.68
Reedy Point.....	39 33 47.41	75 33 44.89	199 14 39 312 33 59	Finn's Point..... Elsinborough Point.....	19 15 16 132 35 15	4270.5 3905.1	4670.1 4270.5	2.65 2.43
Bombay Hook.....	39 18 48.79	75 26 05.49	217 34 50 340 14 07	Pine Mount..... Deep Water.....	37 38 44 160 16 09	14472.7 13676.7	15826.9 14956.4	8.99 8.50

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Liston.....	39 25 00.06	75 32 34.55	269 53 00 320 50 28	Pine Mount..... Bombay Hook.....	90 01 01 140 54 35	18132.2 14758.0	19828.8 16138.9	11.27 9.17
Round Island.....	39 25 18.79	75 27 13.74	85 43 29 352 15 34	Liston..... Bombay Hook.....	265 40 05 172 16 17	7694.4 12136.9	8414.4 13272.6	4.78 7.54
Stony Point.....	39 27 29.89	75 30 49.85	28 27 85 308 01 11	Liston..... Round Island.....	208 26 29 128 03 28	5255.0 6561.0	5746.7 7174.9	3.27 4.08
Appoquinimink.....	39 27 54.73	75 35 10.18	276 59 27 325 20 56	Stony Point..... Liston.....	97 02 12 145 22 35	6269.7 6546.7	6856.4 7159.3	3.90 4.07
Port Penn.....	39 31 17.20	75 34 04.55	326 24 41 14 06 14	Stony Point..... Appoquinimink.....	146 26 45 194 05 33	8412.7 6437.7	9199.9 7040.1	5.23 4.00
Alloway's Point.....	39 30 04.77	75 31 30.83	121 19 44 52 36 04	Port Penn..... Appoquinimink.....	301 18 06 232 33 45	4297.8 6599.6	4700.0 7217.1	2.67 4.10
Elsinborough Point.....	39 32 21.74	75 31 44.41	355 36 25 59 16 19	Alloway's Point..... Port Penn.....	175 36 34 239 14 50	4236.3 3893.4	4632.7 4257.7	2.63 2.42
St. George's Creek.....	39 33 01.74	75 33 46.15	292 59 19 7 45 44	Elsinborough Point..... Port Penn.....	113 00 36 187 45 32	3157.3 3253.5	3452.7 3557.9	1.96 2.02
Reedy Island Light-house.....	39 30 00.15	75 33 49.41	171 20 56 267 31 51	Port Penn..... Alloway's Point.....	351 20 46 87 33 19	2402.7 3314.0	2627.5 3624.1	1.49 2.06
Barney's House.....	39 27 28.11	75 34 51.67	151 47 01 269 24 14	Appoquinimink..... Stony Point.....	331 46 49 89 26 48	934.7 5781.4	1022.2 6322.4	0.58 3.59
Blackbird's Creek.....	39 26 42.27	75 34 05.47	325 23 29 252 32 41	Liston..... Stony Point.....	145 24 27 72 37 45	3829.0 4902.2	4187.3 5360.9	2.38 3.05

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

S. Doc. 3.

307

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Collins.....	39 23 44.87	75 31 17.88	141 39 51 251 02 57	Liston..... Barker.....	321 39 02 71 09 00	2956.6 14459.5	3233.3 15812.5	1.84 8.98
DELAWARE BAY.								
Bombay Hook North	39 21 17.20	75 29 46.01	149 36 21 231 09 03	Liston..... Barker.....	329 34 34 51 14 08	7968.3 14739.2	8713.9 16118.4	4.95 9.16
Bombay Hook Light-house ..	39 21 46.22	75 30 18.92	312 01 01 214 02 25	Bombay Hook..... Round Island.....	132 03 42 34 04 23	8170.9 7912.0	8935.5 8652.3	5.08 4.92
Arnold.....	39 23 14 78	75 25 40.49	4 10 34 108 10 57	Bombay Hook..... Liston.....	184 10 18 288 06 34	8224.4 10424.5	8994.0 11399.9	5.11 6 48
Liston's Point.....	39 25 00.47	75 31 59.48	89 12 16 323 29 31	Liston..... Bombay Hook.....	269 11 54 143 33 16	838.8 14252.9	917.3 15596.5	0.52 8.86
Ben Davis.....	39 17 12.09	75 17 09.57	103 07 13 164 33 20	Bombay Hook..... Pine Mount.....	283 01 34 344 31 34	13181.2 14988.5	14414.6 16391.0	8.19 9.31
Egg Island Light-house	39 10 30.89	75 08 01.74	96 41 41 179 50 22	Deep Water..... Joscelyne.....	276 32 18 359 50 21	21524.6 14989.8	23538.7 16392.4	13.37 9.31
Egg Island Point.....	39 10 23.53	75 07 49.00	133 11 21 97 11 29	Ben Davis..... Deep Water.....	313 05 27 277 02 08	18423.7 21855.0	20147.6 23900.0	11.45 13.58
Big Island.....	39 19 45.61	75 18 14.08	81 13 10 341 54 38	Bombay Hook..... Ben Davis.....	261 08 11 161 55 28	11425.9 4979.2	12495.0 5445.1	7.10 3.11
Dunk's Beach.....	39 20 32.91	75 21 50.90	198 20 46 285 40 16	Pine Mount..... Big Island.....	18 21 56 105 42 31	8696.4 5392.9	9510.1 5897.5	5.40 3.35

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

208

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Goose Point	39 15 05.87	75 23 36.30	195 59 52 247 11 19	Pine Mount	16 02 11	19079.2	20864.4	11.86
				Ben Davis.....	67 15 24	10053.2	10993.9	6.25
Bush Hill	39 23 56.56	75 15 23.71	106 51 25 55 54 41	Pine Mount	286 48 32	6816.3	7254.1	4.24
				Dunks' Beach	235 50 27	11194.3	12241.8	6.96
Harris.....	39 25 06.89	75 17 16.25	37 54 16 308 50 38	Dunks' Beach	217 51 22	10704.1	11705.7	6.65
				Bush Hill	128 51 58	3456.9	3780.4	2.15
Wheaton.....	39 23 26.60	75 19 05.89	220 17 27 157 20 47	Harris	40 18 37	4055.1	4434.5	2.52
				Pine Mount	337 20 15	3140.1	3433.9	1.95
Hann, No. 2.....	39 25 24.01	75 15 07.01	8 25 41 80 19 19	Bush Hill	188 25 34	2725.8	2980.9	1.69
				Harris	260 17 52	3135.5	3428.9	1.95
Garrison	39 23 33.66	75 13 02.91	101 51 21 138 54 32	Bush Hill	281 49 52	3441.9	3763.9	2.14
				Hann, No. 2	318 53 13	4515.6	4938.1	2.81
Buck	39 25 07.50	75 13 16.99	100 57 37 353 21 35	Hann, No. 2	280 56 27	2680.0	2930.8	1.67
				Garrison	173 21 43	2913.2	3185.8	1.81
Mount Pleasant.....	39 23 21.96	75 15 02.76	135 23 30 178 27 04	Harris	315 21 55	4546.2	4971.6	2.83
				Hann, No. 2	358 27 01	3764.9	4117.2	2.34
Hensted, No. 2.....	39 22 55.14	75 18 38.64	205 52 23 154 18 13	Harris	25 53 15	4515.6	4938.1	2.81
				Pine Mount	334 17 24	4292.6	4694.3	2.67
Dayre	39 21 44.55	75 19 53.57	326 59 13 51 49 29	Big Island.....	147 00 16	4373.3	4782.5	2.72
				Dunks' Beach	231 48 15	3573.5	3907.9	2.22
Sheppard	39 22 38.22	75 21 03.34	16 25 12 314 44 11	Dunks' Beach	196 24 42	4028.3	4405.2	2.50
				Dayre	184 44 55	2351.0	2571.0	1.46

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' '	To station—	Back azimuth.			Distance.	Distance.	Distance.	Distance.
					°	'	"				
Greenwich	39 23 24.39	75 20 21.71	347 39 35 34 59 02	Dayre	167	39	53	Metres. 3151.5	Yards. 3446.4	Miles. 1.96	
				Sheppard	214	58	35	1737.6	1900.2	1.08	
Davis.....	39 22 37.32	75 20 11.84	91 16 56 170 45 18	Sheppard	271	16	25	1232.9	1348.3	0.77	
				Greenwich	350	45	12	1470.4	1608.0	0.91	
Cohansey Light-house.....	39 20 18.39	75 21 17.48	192 33 20 68 11 42	Pine Mount	12	34	10	8914.9	9749.0	5.54	
				Bombay Hook	248	08	39	7430.6	8125.9	4.62	
Thumbcap	39 16 27.41	75 24 43.13	155 38 55 208 34 28	Bombay Hook	335	38	03	4784.9	5232.6	2.97	
				Dunks' Beach	28	36	17	8621.3	9428.0	5.36	
Fortesque	39 14 09.39	75 09 59.99	118 43 13 77 07 58	Ben Davis.....	298	38	41	11738.1	12836.4	7.29	
				Deep Water.....	256	59	49	19018.1	20797.6	11.82	
Flax Farm	39 16 33.25	75 12 54.39	101 06 12 316 40 49	Ben Davis.....	281	03	24	6232.0	6815.1	3.87	
				Fortesque	136	42	45	6095.3	6665.6	3.79	
Eagle Island.....	39 17 46.00	75 14 07.56	76 32 12 122 00 33	Ben Davis.....	256	30	28	4484.6	4904.2	2.79	
				Big Island.....	301	57	46	6962.0	7613.4	4.33	
Nantuxent	39 16 33.54	75 14 25.95	106 52 48 191 09 26	Ben Davis.....	286	51	04	4097.3	4480.7	2.55	
				Eagle Island.....	11	09	36	2276.9	2490.0	1.42	
West Point.....	39 19 03.05	75 15 10.69	39 47 11 106 38 48	Ben Davis.....	219	45	56	4451.5	4868.0	2.77	
				Big Island.....	286	36	52	4584.0	5012.9	2.85	
East Point	39 11 28.35	75 00 58.06	110 57 14 78 34 44	Fortesque.....	290	51	31	13915.6	15217.7	8.65	
				Egg Island Point.....	258	30	24	10062.5	11004.1	6.25	
Egg Island Point, (2)	39 10 21.79	75 07 45.94	97 18 37 133 09 19	Deep Water.....	277	09	04	21935.4	23987.9	13.63	
				Ben Davis.....	313	03	23	18514.2	20246.6	11.50	

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

310

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Clark's Point.....	39 01 20.17	75 20 13.02	227 00 00 168 51 44	Egg Island Point, (2)..... Deep Water.....	47 07 51 348 50 02	24517.8 19836.0	26811.9 21692.1	15.23 12.32
Port Norris.....	39 14 33.03	75 00 57.47	0 08 34 52 06 28	East Point Egg Island Point.....	180 08 34 232 02 08	5694.6 12516.3	6227.4 13687.5	3.54 7.78
Dividing Creek	39 15 16.96	75 05 04.11	73 39 31 23 37 38	Fortesque..... Egg Island Point.....	253 36 24 203 35 54	7394.0 9874.8	8085.9 10798.8	4.59 6.14
Turkey Point.....	39 14 55.97	75 07 21.46	69 18 45 4 30 01	Fortesque..... Egg Island Point.....	249 17 05 184 29 44	4063.6 8426.9	4443.8 9215.4	2.53 5.24
Muddy Creek.....	38 58 58.86	75 18 28.29	216 11 23 165 05 10	Egg Island Point, (2)..... Deep Water.....	36 18 08 345 02 23	26111.0 24652.0	28554.2 26958.7	16.22 15.32
Town Bank.....	38 58 36.94	74 57 21.96	145 26 52 91 22 50	Egg Island Point, (2)..... Muddy Creek.....	325 20 19 271 09 33	26405.9 30484.0	28876.7 33336.4	16.41 18.94
Cape Henlopen	38 46 45.11	75 04 44.55	138 48 18 205 52 52	Muddy Creek..... Town Bank.....	318 39 41 25 57 30	30099.4 24403.5	32915.8 26686.9	18.70 15.16
Cape Henlopen Light-house.	38 46 38.35	75 04 43.24	205 36 11 139 01 11	Town Bank..... Muddy Creek.....	25 40 48 318 52 33	24579.1 30277.2	26879.0 33110.2	15.27 18.81
Plumb Point.....	38 50 11.33	75 12 59.40	297 59 51 235 18 04	Cape Henlopen Town Bank.....	118 05 01 55 27 54	13525.4 27442.7	14797.4 30010.2	8.40 17.05
Pilot Town	38 47 07.50	75 09 12.08	276 04 54 135 57 58	Cape Henlopen Plumb Point.....	96 07 39 315 55 38	6493.0 7886.4	7100.5 8624.3	4.03 4.90
Breakwater Light-house.....	38 47 53.64	75 06 08.58	316 10 38 212 33 53	Cape Henlopen Town Bank.....	136 11 31 32 39 24	2928.7 23547.7	3202.7 25751.1	1.82 14.63

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.	
Cape Henlopen Beacon	38 47 25.07	75 04 49.77	354 09 59 85 07 51	Cape Henlopen	174 10 02	1238.7	1354.6	0.77	
				Pilot Town	265 05 07	6352.9	6947.3	3.95	
Ice-breaker West	38 47 58.44	75 06 41.79	308 37 26 66 35 40	Cape Henlopen	128 38 40	3621.6	3960.5	2.25	
				Pilot Town	246 34 06	3951.9	4321.7	2.46	
Bowers	39 03 42.04	75 23 28.20	241 20 38 320 24 47	Egg Island Point, (2)	61 30 33	25772.4	28184.0	16.01	
				Muddy Creek	140 27 57	11325.9	12385.7	7.04	
Kitt's Hammock	39 06 04.35	75 23 46.82	250 55 52 186 54 59	Egg Island Point, (2)	71 05 59	24401.6	26684.9	15.16	
				Deep Water	6 55 33	10777.5	11786.0	6.70	
Little Creek	39 09 21.90	75 24 03.86	200 19 31 265 24 58	Deep Water	20 20 16	4913.6	5373.4	3.05	
				Egg Island Point, (2)	85 35 16	23546.9	25750.2	14.63	
Mahon's River Light-house ..	39 10 16.40	75 23 43.43	269 30 04 340 02 43	Egg Island Point, (2)	89 40 09	22981.9	25132.3	14.28	
				Muddy Creek	160 06 03	22222.3	24301.6	13.81	
West Creek	39 10 27.02	74 54 44.79	89 34 35 9 48 09	Egg Island Point, (2)	269 26 22	18749.1	20503.5	11.65	
				Town Bank	189 46 30	22218.4	24297.4	13.80	
Bird Island	39 11 44.34	75 01 09.96	347 15 49 284 25 50	Town Bank	167 18 12	24889.8	27218.7	15.47	
				West Creek	104 29 53	9545.4	10438.6	5.93	
Elder Point	39 12 39.59	75 02 32.32	213 01 28 310 45 34	Port Norris	33 02 28	4172.2	4562.6	2.59	
				Bird Island	130 46 26	2608.9	2853.0	1.62	
Tomlin	39 13 43.58	74 59 49.96	133 17 17 27 33 58	Port Norris	313 16 34	2224.2	2432.3	1.38	
				Bird Island	207 33 07	4147.2	4535.3	2.58	
Wiggins	39 14 33.23	74 59 47.70	89 47 33 20 45 23	Port Norris	269 46 49	1673.4	1830.0	1.04	
				Bird Island	200 44 31	5569.0	6090.1	5.46	

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

312

S. Doc. 32.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Oranoken	39 12 04.47	75 06 24.62	31 39 04 274 40 16	Egg Island Point, (2)..... Bird Island.....	211 38 13 94 43 35	3719.0 7575.0	4067.0 8283.8	2.31 4.71
Pierce's Landing	39 04 54.33	74 54 05.78	117 12 42 174 47 06	Egg Island Point, (2)..... West Creek.....	297 04 06 354 46 41	22134.8 10301.0	24025.9 11264.9	13.75 6.40
Goshen	39 07 36.35	74 53 10.93	156 49 40 103 43 34	West Creek..... Egg Island Point, (2).....	336 48 41 283 34 21	5724.7 21618.7	6260.4 23641.6	3.56 13.43
Fishing Creek	39 01 04.08	74 56 32.26	136 47 36 188 27 08	Egg Island Point, (2)..... West Creek.....	316 40 31 8 28 16	23617.1 17549.6	25826.9 19191.7	14.67 10.90
Robinson.....	39 11 23.73	74 59 22.90	327 35 14 284 39 34	Pierce's Landing..... West Creek.....	147 38 36 104 42 26	14218.2 6899.4	15548.6 7545.0	8.83 4.29
Carlisle	39 12 03.25	74 56 48.15	315 03 35 71 50 37	West Creek..... Robinson	135 04 53 251 48 59	4191.5 3907.8	4583.7 4273.5	2.60 2.43
Ludlum's Landing.....	39 10 38.46	74 50 50.00	86 26 15 31 04 53	West Creek..... Goshen	266 33 47 211 03 24	5646.2 6556.3	6174.5 7169.8	3.51 4.07
McCrea.....	39 09 49.32	74 50 26.09	100 37 35 159 15 31	West Creek..... Ludlum's Landing.....	280 34 52 339 15 16	6317.6 1620.4	6909.4 1772.0	3.93 1.01
Stipson	39 11 51.41	74 54 18.31	13 43 16 304 01 32	West Creek..... McCrea.....	193 42 59 124 03 58	2678.9 6726.0	2929.6 7355.4	1.67 4.18
Mispilion Light-house.....	38 56 38.00	75 18 29.37	180 20 34 312 31 21	Muddy Creek..... Cape Henlopen	00 20 35 132 39 59	4343.4 27010.4	4749.8 29537.8	2.70 16.78
Doctor's Island	38 54 33.09	75 17 45.67	307 23 16 172 51 52	Cape Henlopen	127 31 26 352 51 25	23726.8 8258.7	25946.9 9031.5	14.74 5.13

United States Coast Survey.—Geographical Positions. Section II.—Delaware Bay. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Hog Island.....	38 53 29.92	75 16 25.17	306 23 39 163 42 52	Cape Henlopen..... Muddy Creek.....	126 30 58 343 41 35	21006.3 10566.8	22971.9 11555.5	13.05 6.57
Potter.....	38 56 40.68	75 20 41.75	217 00 20 271 28 25	Muddy Creek..... Mispilion Light-house.....	37 01 44 91 29 48	5336.2 3188.6	5835.5 3487.0	3.32 1.98
Primrose.....	38 58 12.75	75 20 11.44	240 11 36 14 25 12	Muddy Creek..... Potter.....	60 12 41 194 24 53	2860.6 2924.7	3128.3 3198.4	1.78 1.82
Gerdes' Camp.....	38 56 05.97	75 18 39.64	182 56 05 150 31 32	Muddy Creek..... Primrose.....	2 56 12 330 30 34	5337.9 4490.8	5837.4 4911.0	3.32 2.79
Carpenter.....	38 56 02.91	75 19 50.08	199 56 28 266 48 44	Muddy Creek..... Gerdes' Camp.....	19 57 19 86 49 28	5771.5 1698.8	6311.5 1857.8	3.59 1.06
Slaughter Creek.....	38 51 48.15	75 14 35.09	303 12 46 322 17 23	Cape Henlopen..... Plumb Point.....	123 18 56 142 18 24	17035.2 3774.2	18629.2 4127.4	10.58 2.35
Fisher.....	38 47 35.81	75 12 19.81	278 03 34 168 44 27	Cape Henlopen..... Plumb Point.....	98 08 19 348 44 02	11096.8 4889.1	12135.1 5346.1	6.89 3.04
Lewes Entrance.....	38 48 48.24	75 11 32.41	291 03 43 27 07 07	Cape Henlopen..... Fisher.....	111 07 53 207 06 42	10548.0 2508.8	11535.0 2743.6	6.55 1.56
Hazard.....	38 48 45.22	75 12 29.88	288 12 51 164 59 37	Cape Henlopen..... Plumb Point.....	108 17 43 344 59 18	11822.7 2748.5	12929.0 3005.7	7.35 1.71
Lewes Spire.....	38 46 28.28	75 08 08.27	263 57 37 131 14 20	Cape Henlopen..... Lewes Entrance.....	83 59 45 311 12 12	4944.0 6548.6	5406.6 7161.4	3.07 4.07
Holsten.....	38 49 16.33	75 13 55.04	289 17 48 218 21 29	Cape Henlopen..... Plumb Point.....	109 23 33 38 22 04	14076.4 2162.4	15393.5 2364.7	8.75 1.34

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Big Tree.....	38 45 44.63	75 11 05.60	219 44 46 258 30 25	Town Bank.....	39 53 23	31003.3	33904.3	19.26
Cape May Old Light-house...	38 55 48.64	74 57 38.90	101 08 35 151 35 26	Cape Henlopen.....	78 34 24	9384.5	10262.6	5.83
COAST OF NEW JERSEY.				Muddy Creek.....	280 55 27	30646.1	33513.6	19.04
FROM CAPE MAY TO GREAT EGG HARBOR.				Egg Island Point, (2).....	331 29 03	30625.2	33490.8	19.03
Two-mile Beach.....	38 57 26.13	74 50 40.10	102 45 16 45 54 58	Town Bank.....	282 41 03	9916.7	10844.6	6.16
Congress Hall.....	38 55 51.01	74 55 09.77	148 07 42 245 40 09	Cape Henlopen.....	225 46 08	28372.4	31027.2	17.63
Higbee.....	38 57 14.12	74 57 31.95	185 22 18 306 48 11	Town Bank.....	328 06 19	6024.9	6588.6	3.74
Cape May New Light-house...	38 55 50.42	74 57 15.57	178 16 42 269 38 30	Two-mile Beach.....	65 43 00	7125.2	7791.9	4.43
Week's Landing.....	38 58 55.59	74 52 49.60	30 40 36 311 29 00	Town Bank.....	5 22 24	2565.2	2805.2	1.59
Leaming's Point.....	39 00 56.64	74 50 58.48	32 42 52 356 05 56	Congress Hall.....	126 49 40	4276.1	4676.2	2.66
Nummy's Island.....	39 01 39.50	74 47 09.31	76 32 18 33 00 42	Two-mile Beach.....	358 16 38	5137.6	5618.3	3.19
				Leaming's Point.....	89 39 49	3029.5	3313.0	1.88
				Two-mile Beach.....	210 39 08	6615.7	7234.7	4.11
					131 30 21	4162.5	4552.0	2.59
					212 40 14	11197.8	12245.6	6.96
					176 06 08	6506.0	7114.8	4.84
					256 29 54	5668.4	6198.8	3.52
					212 58 29	9314.5	10186.1	5.79

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Crese.....	39 03 00.05	74 49 28.91	29 31 15 306 29 00	Leaming's Point..... Nummy's Island.....	209 30 19 126 30 28	4372.6 4175.9	4781.7 4566.6	2.72 2.59
Cyrus.....	39 04 28.55	74 44 01.20	70 55 22 40 57 48	Crese..... Nummy's Island.....	250 51 57 220 55 49	8336.7 6901.2	9116.8 7546.9	5.18 4.29
Eldridge.....	39 06 03.41	74 47 17.07	358 41 07 301 50 28	Nummy's Island..... Cyrus.....	178 41 12 121 52 31	8139.8 5541.9	8901.4 6060.5	5.06 3.44
Holmes.....	39 07 32.71	74 45 53.73	36 01 43 334 31 48	Eldridge..... Cyrus.....	216 00 50 154 32 59	3404.9 6289.6	3723.5 6878.1	2.12 3.91
Leaming's Beach North.....	39 06 26.06	74 42 12.54	84 34 29 35 47 04	Eldridge..... Cyrus.....	264 31 17 215 45 53	7349.9 4466.7	8037.7 4884.6	4.57 2.78
Townsend.....	39 10 23.84	74 43 09.98	349 20 29 36 42 06	Leaming's Beach North..... Holmes.....	169 21 05 216 40 23	7460.6 6580.4	8158.7 7196.1	4.64 4.09
Ludlam's Beach.....	39 08 41.50	74 41 29.69	71 31 38 142 40 13	Holmes..... Townsend.....	251 28 51 322 39 10	6686.0 3969.4	7311.6 4340.8	4.15 2.47
Corson.....	39 13 41.40	74 40 35.77	7 58 13 31 17 11	Ludlam's Beach..... Townsend.....	187 57 39 211 15 34	9337.7 7127.2	10211.4 7794.1	5.80 4.44
Mountain Creek.....	39 11 42.80	74 38 51.74	68 34 28 34 09 24	Townsend..... Ludlam's Beach.....	248 31 45 214 07 44	6658.2 6754.8	7281.2 7386.9	4.14 4.20
Weakfish Creek.....	39 13 28.80	74 37 38.73	95 14 46 28 11 36	Corson..... Mountain Creek.....	275 12 54 208 10 50	4263.8 3708.1	4662.8 4055.1	2.65 2.30
Blackman.....	39 15 04.74	74 39 13.93	37 22 27 322 20 11	Corson..... Weakfish Creek.....	217 21 35 142 21 11	3233.4 3736.9	3535.9 4086.6	2.01 2.32

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Beasley's Point	39 16 46.91	74 37 21.48	3 52 21 40 33 23	Weakfish Creek.....	183 52 10	6123.0	6695.9	3.80
				Blackman.....	220 32 12	4146.1	4534.1	2.58
Peck's Beach.....	39 16 11.77	74 34 51.52	38 35 43 71 49 56	Weakfish Creek.....	218 33 57	6428.6	7030.1	3.99
				Blackman.....	251 47 10	6621.2	7240.7	4.11
Somers' Point.....	39 18 38.78	74 35 02.95	356 32 32 43 54 34	Peck's Beach.....	176 32 39	4541.3	4966.2	2.82
				Beasley's Point.....	223 53 08	4786.9	5234.8	2.97
New Inlet.....	39 19 08.49	74 30 30.65	48 56 30 82 01 45	Peck's Beach.....	228 53 45	8292.4	9068.3	5.15
				Somers' Point.....	261 58 52	6586.3	7202.6	4.09
Risley's Landing	39 22 48.75	74 31 11.49	35 44 07 351 48 18	Somers' Point.....	215 41 40	9493.6	10382.0	5.90
				New Inlet.....	171 48 44	6862.1	7504.2	4.26
Dry Inlet.....	39 20 31.28	74 27 57.42	55 10 59 132 23 53	New Inlet.....	235 09 22	4470.2	4888.5	2.78
				Risley's Landing	312 21 50	6288.7	6877.1	3.91
Leedsville.....	39 20 52.82	74 33 19.98	220 41 53 30 49 53	Risley's Landing	40 43 15	4715.9	5157.2	2.93
				Somers' Point.....	210 48 48	4812.8	5263.1	2.99
FROM HIGHLANDS OF NAVE- SINK TO GT. EGG HARBOR.								
Navesink.....	40 23 45.06	73 58 49.77	126 08 31 166 24 57	Mount Mitchell	306 07 41	2234.3	2443.4	1.39
				Sandy Hook.....	346 24 03	7524.5	8228.6	4.67
Navesink Light-house.....	40 23 42.43	73 58 48.62	183 16 14 221 17 29	Wyckoff.....	3 16 45	19941.7	21807.6	12.39
				Pavilion.....	41 26 30	29682.5	32459.8	18.44
Polhemus.....	40 19 00.00	74 08 36.62	133 02 12 229 55 34	Beacon Hill	312 59 07	9213.4	10075.5	5.72
				Mount Mitchel	30 01 05	15720.5	17191.5	9.77

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Lippencott	40 15 17.63	74 07 18.27	83 32 44 164 54 23	Throckmorton	263 30 43	4528.6	4952.4	2.81
				Polhemus.....	344 53 33	7103.6	7768.3	4.41
Garriell	40 20 31.69	74 02 45.79	33 37 16 71 10 41	Lippencott	213 34 19	11628.5	12716.6	7.22
				Polhemus	251 06 54	8750.5	9569.3	5.44
Burdge	40 22 59.43	74 01 25.80	22 30 21 54 02 45	Garriell.	202 29 29	4931.9	5393.4	3.06
				Polhemus	233 58 06	12564.9	13740.6	7.81
Beach, (1).....	40 20 39.12	73 58 01.68	88 04 04 131 57 44	Garriell	268 01 00	6708.6	7336.3	4.17
				Burdge.....	311 55 32	6474.0	7079.8	4.02
Beach, (2).....	40 20 11.87	73 58 02.84	95 15 19 137 12 00	Garriell	275 12 16	6705.7	7333.2	4.17
				Burdge	317 09 49	7045.2	7704.4	4.38
Navesink, (2).....	40 23 15.34	73 58 53.50	47 22 30 348 04 08	Garriell	227 19 58	7450.4	8147.5	4.63
				Beach, (2).....	168 04 40	5783.5	6324.7	3.59
Ocean House, (flag-staff)	40 22 51.74	73 58 13.90	356 58 09 93 00 53	Beach, (2).....	176 58 16	4937.7	5399.7	3.07
				Burdge	272 58 49	4532.2	4956.3	2.82
Shrewsbury Spire	40 19 22.20	74 03 21.63	51 25 57 84 45 44	Throckmorton	231 21 22	12908.2	14116.0	8.02
				Polhemus.....	264 42 20	7468.3	8167.0	4.64
Conover	40 20 38.28	74 01 07.42	263 37 42 174 18 54	Garriell	139 59 56	2330.3	2548.3	1.45
				Burdge	354 18 42	4374.7	4784.0	2.72
Liberty Pole.....	40 17 55.55	73 59 52.30	139 41 23 99 10 28	Garriell	319 39 30	6316.1	6907.1	3.92
				Polhemus.....	279 04 49	12530.3	13702.8	7.79
West	40 16 16.24	73 59 34.71	150 13 24 196 36 42	Garriell	330 11 20	9079.1	9928.6	5.64
				Beach, (2).....	16 37 38	7584.5	8294.2	4.71

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.	Distance.	Distance.
					°	'	"			
Red Bog	40 14 03.28	74 02 54.16	228 54 30 180 53 52	West	48	56	39	Metres. 6238.2 11979.2	Yards. 6821.9 13100.2	Miles. 3.88 7.44
Christopher	40 04 10.42	74 11 36.75	184 35 01 135 10 47	Throckmorton	4	35	45	22014.5	22014.5	12.51
				Baird	315	02	28	25971.4	28401.5	16.14
Highland of Squam	40 06 07.68	74 04 17.70	151 57 13 70 52 01	Throckmorton	331	53	14	18644.8	20389.4	11.59
				Christopher	250	47	18	11011.0	12041.3	6.84
Fleming	40 00 12.97	74 03 11.79	171 52 49 121 30 08	Highland of Squam	351	52	07	11050.0	12083.9	6.86
				Christopher	301	24	43	14032.3	15345.3	8.72
Stout	39 57 34.71	74 04 15.43	139 25 33 197 11 02	Christopher	319	20	49	16076.0	17580.2	9.99
				Fleming	17	11	43	5108.9	5586.9	3.17
Green Island	40 00 32.22	74 06 06.49	334 17 26 278 08 24	Stout	154	18	37	6075.1	6643.5	3.77
				Fleming	98	10	16	4185.7	4577.4	2.60
Page	39 59 06.18	74 06 48.18	248 06 48 200 25 57	Fleming	68	09	07	5530.6	6048.1	3.44
				Green Island	20	26	24	2831.8	3096.7	1.76
Cranberry	39 56 37.21	74 03 58.55	189 27 40 138 47 21	Fleming	9	28	10	6745.6	7376.8	4.19
				Page	318	45	32	6108.0	6679.5	3.79
Goose Creek	39 57 04.97	74 06 20.38	252 48 13 169 59 31	Stout	72	49	33	3104.4	3394.4	1.93
				Page	349	59	13	3795.6	4150.8	2.36
Goodluck Point	39 55 18.58	74 06 47.10	190 56 34 238 46 13	Goose Creek	10	56	51	3341.8	3654.5	2.08
				Cranberry	58	48	01	4679.0	5116.8	2.91
Philipp	39 53 50.37	74 04 25.90	155 38 37 187 11 27	Goose Creek	335	37	24	6588.2	7204.7	4.09
				Cranberry	7	11	44	5186.1	5671.4	3.22

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.	
						Metres.	Yards.
Cedar Creek	39 51 44.44	74 07 52.94	231 41 24 193 19 04	Philipp	51 43 37 13 19 46	6267.6	6854.0
						6786.8	7421.9
Island Beach	39 49 02.52	74 05 08.73	186 32 19 141 59 47	Philipp	6 32 46 321 58 02	8935.3	9771.4
						6338.2	6931.3
Forked River	39 49 19.83	74 09 08.41	201 54 35 275 19 50	Cedar Creek	21 55 23 95 22 24	4806.7	5256.5
						5724.6	6260.2
Barnegat Inlet	39 45 55.47	74 05 55.43	190 53 47 143 56 41	Island Beach	10 54 17 323 54 38	5874.2	6423.9
						7797.1	8526.7
Double Creek	39 44 24.84	74 10 20.39	246 04 28 190 39 17	Barnegat Inlet	66 07 51 10 40 03	6898.6	7544.1
						9257.1	10123.3
Barnegat Light-house	39 45 57.21	74 06 02.20	144 40 56 192 32 41	Forked River	324 38 57 12 33 15	7659.3	8376.0
						5854.4	6402.2
Great Swamp	39 40 39.53	74 08 39 32	160 53 50 201 48 55	Double Creek	340 52 45 21 50 40	7353.3	8041.4
						10495.9	11478.0
Hickory Island	39 41 11.94	74 12 43.12	209 44 04 279 44 25	Double Creek	29 45 35 99 47 00	6851.2	7492.3
						5894.7	6446.3
Hickey	39 37 34.20	74 11 03.36	160 30 25 210 59 06	Hickory Island	340 29 21 31 00 38	7123.2	7789.7
						6667.2	7291.0
Dinner Point	39 37 57.40	74 14 54.94	207 37 45 277 21 40	Hickory Island	27 39 09 97 24 08	6772.0	7405.7
						5568.2	6089.2
Cramer	39 35 09.24	74 12 52.76	150 40 32 210 15 53	Dinner Point	330 39 14 30 16 03	5948.4	6505.0
						5176.1	5660.4

United States Coast Survey.—Geographical Positions. Section II.—Coast of New Jersey. Sketch B, No. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Tuckerton	39 36 06.69	74 19 27.59	242 16 25 280 36 55	Dinner Point	62 19 13	7344.4	8031.6	4.56
Long Beach	39 33 15.89	74 14 21.23	211 07 42 125 47 52	Cramer	100 41 07	9584.7	10481.5	5.96
Cedar Hammock	39 34 07.05	74 20 19.06	198 24 29 280 25 56	Tuckerton	31 08 38	4083.7	4465.8	2.54
Old Inlet	39 30 48.76	74 16 53.31	218 39 29	Tuckerton	305 44 37	9010.1	9853.2	5.60
Leed's Point	39 28 58.63	74 25 39.63	218 48 12 254 50 19	Long Beach	18 25 02	3888.5	4252.3	2.41
Little Egg Harbor Light	39 30 18.41	74 16 48.02	144 27 54 79 05 03	Cedar Hammock	100 29 44	8685.2	9497.9	5.40
Brigantine Beach	39 25 48.98	74 19 37.01	202 55 26 124 02 20	Long Beach	321 12 09	7843.4	8577.3	4.87
Peter's Beach	39 23 16.50	74 24 01.60	167 28 56 233 22 09	Cedar Hammock	38 41 06	5811.2	6354.9	3.61
Absecum	39 25 08.55	74 29 06.57	214 52 10 295 18 58	Leed's Point	38 51 36	12209.0	13351.4	7.58
				Brigantine Beach	74 55 54	13024.6	14243.3	8.09
				Leed's Point	324 25 40	8666.0	9476.9	5.38
				Old Inlet	258 59 25	12937.1	14147.6	8.04
				Leed's Point	22 57 10	10038.3	10977.6	6.23
				Brigantine Beach	303 58 29	10456.7	11435.2	6.50
				Leed's Point	347 27 54	10807.4	11818.7	6.72
				Peter's Beach	53 24 57	7882.1	8619.6	4.90
				Absecum	34 54 22	8649.4	9458.7	5.37
					115 22 12	8072.4	8827.7	5.02

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
FROM KENT ISLAND BASE NORTHWARD.								
KENT ISLAND BASE { S. End.	38 53 50.51	76 21 39.35						
{ N. End.	38 58 23.17	76 20 08.46	14 36 02.5	South Base.....	194 35 05.4	8687.6	9500.5	5.40
Marriott	33 52 24.15	76 36 16.41	262 44 36.9	South Base.....	82 53 47.5	21303.3	23296.6	13.24
			244 39 59.1	North Base.....	64 41 07.3	25308.8	28223.7	16.04
Taylor.....	38 59 45.01	76 27 37.08	321 43 49.2	South Base.....	141 47 34.1	13916.6	15218.8	8.65
			283 06 57.1	North Base.....	103 11 39.3	11087.1	12124.5	6.89
			42 39 41.6	Marriott.....	222 34 15.2	18471.5	20199.9	11.48
Linstid.....	39 05 18.39	76 28 49.96	315 32 38.5	North Base.....	135 38 06.9	17922.5	19599.5	11.13
			350 19 04.6	Taylor.....	170 19 50.6	10427.9	11403.6	6.43
			24 16 12.4	Marriott.....	204 11 31.5	26179.3	28328.9	16.27
Swan Point.....	39 08 27.07	76 16 29.54	15 48 06.3	North Base.....	195 45 48.4	19350.3	21160.9	12.02
			71 57 04.5	Linstid.....	251 49 17.4	18713.2	20464.2	11.63
Pool's Island.....	39 17 04.52	76 15 30.40	41 27 23.9	Linstid.....	221 18 58.7	29321.1	31746.6	18.03
			5 05 09.4	Swan Point.....	185 04 32.0	16918.6	17517.5	9.95
Finlay.....	39 24 24.76	76 31 09.65	354 34 31.6	Linstid.....	174 36 00.0	35507.5	38830.0	22.06
			301 02 09.0	Pool's Island.....	121 12 04.5	26267.9	28725.8	16.32
Osborne's Ruin.....	39 27 51.70	76 16 33.85	355 33 35.9	Pool's Island.....	175 39 16.2	20014.5	21887.3	12.44
			73 07 50.9	Finlay.....	252 58 34.6	21892.6	23941.1	13.60
Turkey Point.....	39 26 55.02	76 00 15.68	50 19 51.1	Pool's Island.....	230 10 10.9	28476.6	31141.2	17.70
			94 21 40.1	Osborne's Ruin.....	274 11 18.5	23447.9	25641.9	14.57

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Principio	39 35 33.47	75 59 57.25	59 11 41.5 1 34 44.1	Osborne's Ruin	239 01 07.2	27733.4	30328.4	17.23
				Turkey Point	181 34 32.3	15993.3	17489.8	9.94
FROM CHESAPEAKE BAY TO WASHINGTON.								
Webb	39 05 23.23	76 40 11.42	346 43 51.8 270 27 45.2	Marriott	166 46 19.7	24678.9	26988.1	15.33
				Linstid	90 34 54.9	16375.9	17908.2	10.18
Hill	38 53 51.54	76 52 31.15	276 27 30.5 219 46 58.6	Marriott	96 37 42.5	23644.0	25856.3	14.69
				Webb	39 54 43.9	27779.4	30378.7	17.26
Soper	39 05 08.55	76 56 42.11	268 49 25.7 343 50 36.5 308 31 02.5	Webb	88 59 50.3	23811.0	26039.0	14.79
				Hill	163 53 14.3	21739.9	23764.2	13.50
				Marriott	128 43 53.5	37758.5	41291.6	23.46
Causten	38 55 31.96	77 04 05.29	280 25 45.9 210 54 44.4	Hill	100 33 01.9	17006.0	18597.3	10.57
				Soper	30 59 23.4	20730.7	22670.5	12.88
Seminary	38 49 10.24	77 05 13.71	244 40 32.2 187 58 15.8	Hill	64 48 30.7	20327.2	22229.2	12.63
				Causten	7 58 58.7	11884.7	12996.8	7.38
National Observatory	38 53 38.96	77 02 47.29	248 26 57 151 40 02	Hill	88 33 24	14851.0	16240.6	9.23
				Causten	331 39 13	3958.6	4329.0	2.46
Capitol Dome	38 53 19.89	77 00 15.00	264 58 09 126 17 53	Hill	85 03 01	11219.5	12269.3	6.97
				Causten	306 15 28	6882.0	7526.0	4.28
Seaton	38 53 25.60	76 59 40.98	265 32 46 121 29 01	Hill	85 37 16	10388.0	11360.0	6.45
				Causten	301 26 15	7465.0	8163.5	4.64

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
FROM KENT ISLAND BASE SOUTHWARD.								
Poplar Island, (1).....	38 45 25.65	76 22 53.29	186 31 46.6 123 44 08.3	South Base..... Marriott	6 32 33.7 303 35 44.8	15668.1 23277.1	17114.2 25455.1	9.74 14.46
Blake.....	38 39 41.88	76 31 55.79	165 02 16.3 230 59 16.9	Marriott	344 59 33.1	24330.5	26607.1	15.02
				Poplar Island, (1).....	51 04 56.2	16855.6	18432.8	10.47
Hill's Point.....	38 34 04.14	76 18 37.26	163 36 35.7 118 23 51.6	Poplar Island..... Blake.....	343 33 55.7 298 15 33.3	21905.4 21944.5	23955.1 23997.8	13.61 13.64
Travers.....	38 28 06.84	76 19 30.85	139 59 04.9 186 42 59.9	Blake..... Hill's Point.....	319 51 20.5 6 43 33.3	28007.0 11092.5	30627.6 12130.4	17.40 6.89
Wilson	38 26 18.29	76 26 39.38	162 50 44.0 219 04 39.4 252 06 29.6	Blake..... Hill's Point..... Travers.....	342 47 26.8 39 09 39.4 72 10 56.1	25933.6 18512.9 10915.0	28360.2 20245.2 11936.3	16.12 11.50 6.78
Calvert	38 21 30.68	76 23 16.16	204 05 13.0 150 56 27.7	Travers..... Wilson	24 07 33.0 330 54 21.5	13381.0 10146.1	14633.1 11095.5	8.31 6.30
Meekin's Neck.....	38 23 10.66	76 16 42.09	155 52 16.6 72 10 11.7	Travers..... Calvert	335 50 31.7 252 06 07.1	10006.8 10048.9	10943.1 10989.2	6.22 6.24
Cedar Point.....	38 17 54.09	76 21 42.77	161 14 57.3 216 46 17.9	Calvert..... Meekin's Neck.....	341 13 59.4 36 49 24.4	7052.2 12188.7	7712.1 12309.2	4.38 7.57
Tom's Point.....	38 15 37.94	76 10 54.48	148 51 42.6 104 58 29.4	Meekin's Neck..... Cedar Point	328 48 07.1 284 51 47.8	16312.5 16304.5	17338.9 17830.1	10.14 10.13

United States Coast Survey.—Geographical Positions. Section III.—Primary Stations. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Point No Point.....	38 08 27.45	76 19 04.11	167 33 27.2 221 52 00.1	Cedar Point..... Tom's Point.....	347 31 49.0 41 57 02.9	17890.8 17833.7	19564.9 19502.4	11.13 11.08
Holland.....	38 06 36.29	76 05 14.88	153 42 03.4 99 42 08.5	Tom's Point..... Point No Point.....	333 33 33.4 279 33 36.6	18631.8 20483.2	20375.2 22399.8	11.58 12.73
Point Lookout.....	38 02 44.75	76 19 04.90	180 06 13.2 250 29 24.1	Point No Point..... Holland.....	0 06 13.7 70 37 56.0	10565.4 21449.4	11554.0 23456.4	6.56 13.33
Smith's Point Light-House...	37 53 14.59	76 13 58.50	165 10 55.4 207 16 40.0 156 57 57.1	Point No Point..... Holland..... Point Lookout.....	345 07 47.0 27 22 02.2 336 54 48.4	29114.3 27819.0 19103.6	31838.5 30422.0 20891.1	18.09 17.28 11.87
Shank's Hammock.....	37 55 15.59	76 02 09.48	167 51 20.6 119 17 13.0 77 54 10.0	Holland..... Point Lookout..... Smith's Point Light House...	347 49 26.5 299 06 48.1 257 46 54.5	21467.4 28383.7 17711.2	23476.1 31039.5 19368.4	13.34 17.64 11.00
Tangier Island.....	37 47 53.82	75 58 56.11	114 13 35.5 160 52 42.1	Smith's Point Light-House... Shank's Hammock.....	294 04 22.0 340 50 43.5	24171.1 14415.7	26432.8 15764.6	15.02 8.96
Windmill Point.....	37 36 41.82	76 16 14.63	186 12 41.9 230 45 04.6	Smith's Point Light-House... Tangier Island.....	6 14 05.4 50 55 39.8	30786.3 32804.5	33667.0 35874.0	19.13 20.37
Sandy Point.....	37 33 38.43	75 56 17.92	171 39 05.4 100 59 55.1	Tangier Island..... Windmill Point.....	351 37 28.7 280 47 45.2	26651.1 29896.2	29144.8 32693.5	16.56 18.58
Wolf Trap.....	37 24 00.73	76 14 24.32	173 25 21.8 236 11 32.0	Windmill Point..... Sandy Point.....	353 24 14.6 56 22 33.1	23617.6 22085.4	25827.5 35087.6	14.67 19.94
Rosemary.....	37 19 54.83	76 00 29.21	193 39 00.0 110 19 14.0	Sandy Point..... Wolf Trap.....	13 41 32.7 290 10 47.1	26130.4 21900.4	28575.3 23949.6	16.24 13.61

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
HEAD OF CHESAPEAKE BAY.								
Maulden's Mountain.....	39 29 11.98	75 59 07.84	174 16 38	Principio.....	354 16 06	11822.5	12928.9	7.35
			84 26 10	Osborne's Ruin.....	264 15 05	25120.0	27470.5	15.60
Prospect Hill.....	39 26 08.83	76 20 36.74	239 25 53	Principio.....	59 33 05	34346.3	37559.1	21.34
			259 29 58	Maulden's Mountain.....	79 43 35	31323.3	34254.2	19.46
Worton Point.....	39 19 03.32	76 10 51.86	133 11 54	Prospect Hill.....	313 05 45	19185.7	20980.9	11.92
			221 50 34	Maulden's Mountain.....	41 58 04	25217.7	27577.3	15.67
Miller's Island.....	39 15 41.74	76 20 52.56	181 07 09	Prospect Hill.....	1 07 17	19340.2	21149.9	12.02
			246 35 29	Worton Point.....	66 41 49	15678.9	17146.0	9.74
Mitchell's Bluff.....	39 13 06.17	76 14 14.83	116 44 07	Miller's Island.....	293 39 55	10675.6	11674.5	6.63
			203 49 03	Worton Point.....	23 51 11	12939.7	13166.3	7.48
SWAN POINT.....	39 08 27.07	76 16 29.54	154 48 33	Miller's Island.....	334 45 47	14814.0	16200.0	9.20
			200 34 49	Mitchell's Bluff.....	20 36 14	9192.9	10053.1	5.71
Black Marsh.....	39 12 25.25	76 25 06.51	225 07 36	Miller's Island.....	45 10 17	8590.2	9394.0	5.34
			300 34 30	Swan Point.....	129 39 57	14419.0	15768.2	8.96
Gibson's Island.....	39 04 36.40	76 25 09.28	240 17 16	Swan Point.....	60 22 46	14370.1	15714.7	8.93
			180 15 46	Black Marsh.....	0 15 45	14456.9	15809.6	8.98
Northeast River.								
Locust Point.....	39 28 21.53	76 03 56.25	257 15 17	Maulden's Mountain.....	77 18 20	7065.0	7726.1	4.39
			203 10 20	Principio.....	23 12 52	14490.0	15845.8	9.00

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Carpenter's Point	39 32 28.79	76 00 20.17	34 06 54 344 06 10	Locust Point	214 04 37	9206.7	10068.2	5.72
				Maulden's Mountain	164 06 56	6309.7	6900.1	3.92
Bull's Mountain	39 30 23.04	75 58 30.95	64 17 28 146 04 57	Locust Point	244 14 02	8627.8	9435.1	5.36
				Carpenter's Point	326 03 46	4673.1	5110.4	2.90
Hance's Point	39 33 20.63	75 57 50.43	13 33 42 63 55 18	Maulden's Mountain	193 32 55	7886.5	8624.5	4.90
				Carpenter's Point	245 53 42	3915.6	4232.0	2.43
Seneca Point	39 33 47.95	75 59 05.49	36 09 01 295 10 45	Carpenter's Point	216 08 13	3022.4	3305.2	1.88
				Hance's Point	115 11 33	1979.6	2164.8	6.82
Ford's Farm	39 34 27.81	75 56 50.04	34 50 41 53 49 42	Hance's Point	214 50 03	2524.2	2760.4	1.57
				Carpenter's Point	233 47 28	6215.7	6797.3	3.86
Red Bank	39 31 38.61	75 58 32.05	120 56 55 61 00 51	Carpenter's Point	300 55 48	3009.7	3291.3	1.87
				Highlands of Narrows	240 56 16	11777.6	12879.6	7.32
Sweet's Landing	39 35 28.10	75 57 15.32	12 02 33 342 00 43	Hance's Point	192 02 13	4018.8	4394.9	2.50
				Ford's Farm	162 00 58	1954.2	2137.1	1.21
<i>Susquehanna River.</i>								
Highlands of Narrows	39 28 33.30	76 05 43.15	262 46 06 212 29 08	Maulden's Mountain	82 50 17	9521.6	10412.5	5.92
				Principio	32 32 48	15365.3	16803.0	9.55
Furnace	39 35 24.37	75 59 51.98	348 14 01 7 05 08	Bull's Mountain	168 14 53	10867.1	11883.9	6.75
				Carpenter's Point	187 04 50	5456.1	5966.6	3.39
Davis' Point	39 30 39.45	76 06 16.07	248 19 47 272 34 01	Carpenter's Point	68 23 33	9144.0	9999.6	5.68
				Bull's Mountain	92 38 57	11121.9	12162.6	6.91

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Shad Battery	39 29 36.53	76 04 41.34	269 45 49 130 37 39	Bull's Mountain..... Davis' Point.....	80 49 45 310 36 39	8963.6 2981.5	9802.3 3260.5	5.57 1.85
Susquehanna Light	39 32 23.28	76 04 47.12	306 01 21 231 34 32	Maulden's Mountain..... Furnace	126 04 57 51 37 40	10023.6 8988.2	10961.6 9829.2	6.23 5.59
Lower Stump Point	39 32 44.56	76 02 39.44	307 19 32 323 32 45	Bull's Mountain..... Maulden's Mountain.....	127 22 01 143 34 59	7194.3 8147.8	7867.5 8910.2	4.47 5.06
Stump Point.....	39 32 58.54	76 03 49.94	302 09 42 18 18 25	Bull's Mountain..... Highlands of Narrows	122 13 09 198 17 17	9001.2 8614.9	9843.4 9421.0	5.59 5.35
Havre-de-Grace.....	39 32 15.63	76 04 57.57	9 01 41 266 28 09	Highlands of Narrows	189 01 12	6942.2	7591.8	4.31
Havre-de-Grace Spire.....	39 32 49.23	76 05 13.63	238 02 52	Carpenter's Point	86 31 06	6636.0	7256.9	4.12
Mount Zion.....	39 33 39.57	76 07 21.80	307 27 00 238 02 52	Maulden's Mountain..... Furnace	127 30 53 58 06 17	11009.5 9044.3	12039.7 9890.6	6.84 5.62
Ryan's Hill.....	39 35 19.40	76 04 20.80	304 55 46 251 38 37	Maulden's Mountain..... Principio.....	125 01 00 71 43 20	14396.6 11175.0	15743.7 12220.7	8.94 6.94
Grover's Hill.....	39 33 44.46	76 05 54.54	8 55 53 317 32 43	Highlands of Narrows	188 55 01	12676.2	13862.3	7.88
Watson's Island.....	39 33 33.30	76 04 52.48	217 22 15 300 20 53	Bull's Mountain.....	137 36 26	12381.2	13539.7	7.69
Boyce's Hill.....	39 35 37.61	76 04 50.43	217 22 15 300 20 53	Ryan's Hill..... Bull's Mountain.....	37 23 09 120 25 41	3685.1 12536.4	4029.9 13709.4	2.29 7.79
			193 00 32 302 44 45	Ryan's Hill..... Bull's Mountain.....	13 00 50 122 48 51	3358.6 10861.2	3672.9 11877.5	2.09 6.74
			308 27 02 0 43 52	Ryan's Hill..... Watson's Island.....	128 27 21 180 43 51	902.8 3834.0	987.3 4192.8	0.56 2.38

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Boyd	39 35 29.87	76 07 22.92	315 01 32 266 14 04	Watson's Island	135 03 08	5080.8	5556.2	3.16
				Boyce's Hill	86 15 41	3646.1	3987.3	2.27
Wells' Hill	39 36 40.60	76 06 57.18	302 42 26 15 43 27	Boyce's Hill	122 43 47	3593.8	3930.1	2.23
				Boyd	195 43 11	2265.8	2477.8	1.41
Lower Island	39 36 17.71	76 07 27.77	225 57 02 355 30 52	Wells' Hill	45 57 21	1015.1	1110.1	0.63
				Boyd	175 30 56	1479.9	1618.4	0.92
Paradise	39 30 50.01	76 08 07.66	283 08 40 234 23 44	Maulden's Mountain	103 14 23	13245.7	14485.1	8.23
				Furnace	54 29 00	14545.4	15906.5	9.04
Paca's House, (south chimney.)	39 32 56.94	76 07 25.58	313 14 32 290 20 37	Highlands of Narrows	163 15 37	8490.1	9284.5	5.28
				Bull's Mountain	110 26 17	13321.1	14895.6	8.46
Mulberry Point	39 26 39.48	76 05 51.45	266 32 08 170 33 30	Turkey Point, (2)	86 35 46	8025.2	8776.1	4.99
				Mount Zion	350 32 28	13133.1	14362.1	8.16
Turkey Point, (2)	39 26 55.06	76 00 16.49	140 52 33 181 38 41	Mount Zion	320 48 03	16088.1	17593.5	10.00
				Principio	1 35 51	15992.6	17489.0	9.94
Turkey Point Light	39 26 56.27	76 00 12.26	116 10 52 214 02 32	Locust Point	296 08 30	5964.4	6522.5	3.71
				Collar Neck	34 03 09	2468.2	2699.2	1.53
Collar Neck	39 28 02.57	75 59 14.47	94 59 17 35 27 23	Locust Point	274 56 18	6759.4	7391.9	4.22
				Turkey Point, (2)	215 26 44	2555.8	2795.0	1.59
Wroth's Point	39 25 47.62	75 59 29.99	126 44 20 185 05 42	Locust Point	306 41 31	7940.0	8682.9	4.93
				Collar Neck	5 05 52	4178.6	4569.6	2.60
Pearce	39 26 24.03	75 57 51.79	64 27 29 146 57 52	Wroth's Point	244 26 26	2603.4	2847.0	1.62
				Collar Neck	326 56 59	3625.5	3964.7	2.25

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Arnold's Bar	39 27 42.67	75 57 40.32	36 28 22 105 15 46	Wroth's Point	216 27 12	4411.9	4824.7	2.74
				Collar Neck	285 14 46	2332.3	2550.5	1.45
<i>Elk River.</i>								
Martin's High Bank	39 29 57.79	75 55 49.52	73 24 55 34 21 19	Maulden's Mountain	253 22 51	4944.6	5497.3	3.07
				Wroth's Point	214 18 57	9343.0	10217.2	5.81
Ford's Landing	39 28 16.06	75 56 28.64	114 23 43 196 35 33	Maulden's Mountain	294 22 02	4176.9	4567.7	2.60
				Martin's High Bank	16 35 58	3273.3	3579.6	2.03
Stony Battery	39 28 03.21	75 54 06.46	106 25 54 145 07 53	Maulden's Mountain	286 22 47	7508.2	8211.1	4.67
				Martin's High Bank	325 06 41	4306.5	4709.9	2.68
Town Point	39 29 42.12	75 54 32.71	104 45 36 81 58 41	Martin's High Bank	284 44 52	1897.6	2075.2	1.18
				Maulden's Mountain	261 55 41	6638.6	7259.8	4.13
Hart's Hill	39 30 42.01	75 56 52.89	298 52 10 11 34 38	Town Point	118 53 49	3323.8	4131.9	2.33
				Arnold's Bar	191 34 16	5644.0	6172.3	3.51
Fairview	39 31 11.98	72 51 50.37	54 27 55 70 32 23	Town Point	234 26 15	4766.3	5212.3	2.96
				Maulden's Mountain	250 27 42	11086.6	12124.2	6.89
Pearce	39 30 56.99	75 53 47.23	25 13 11 84 04 34	Town Point	295 12 42	2551.6	2799.5	1.59
				Hart's Hill	264 02 36	4458.5	4875.7	2.77
Ford	39 28 24.83	75 56 01.93	221 49 36 163 58 22	Town Point	41 50 33	3198.5	3497.8	1.99
				Hart's Hill	343 57 50	4401.4	4813.2	2.74
<i>Bohemia River.</i>								
Folk	39 29 07.03	75 54 52.95	135 33 40 51 44 49	Hart's Hill	315 37 24	4097.2	4480.6	2.55
				Ford	231 44 05	2101.3	2297.9	1.31

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Stony Point	39 28 42.03	75 52 49.93	83 25 54 284 41 59	Ford	263 23 52 104 43 17	4619.1 3038.0	5051.3 3322.3	2.87 1.89
Pennington	39 28 02.29	75 52 53.93	184 24 30 125 04 57	Stony Point	4 24 32 305 03 41	1228.9 3475.0	1344.0 3800.2	0.76 2.16
Bayard	39 27 56.13	75 51 40.99	130 39 28 96 14 08	Stony Point	310 38 44 276 13 22	2173.0 1753.6	2376.3 1917.7	1.35 1.09
McLane	39 27 14.53	75 51 39.96	148 12 11 178 54 22	Stony Point	328 11 26 358 54 21	3175.0 1282.9	3472.2 1403.1	1.97 0.80
<i>Chesapeake Bay.</i>								
Bear Point	39 26 50.62	76 03 24.51	234 34 53 197 44 52	Maulden's Mountain	54 37 36 17 47 07	7525.6 16634.4	8229.9 18190.4	4.63 10.34
Carroll's Island	39 18 44.07	76 18 56.02	26 25 27 170 02 24	Miller's Island	206 24 15 350 01 20	6277.4 13924.6	6864.8 15227.4	3.90 8.65
Cool Spring	39 23 52.04	76 02 00.76	133 07 03 203 50 09	Mulberry Point	313 04 34 23 51 18	7557.9 6171.3	8265.1 6748.8	4.70 3.84
Bare Point	39 26 06.25	76 04 31.75	256 07 31 318 52 30	Turkey Point, (2)	76 10 14 138 54 04	6288.0 5493.6	6876.4 6007.7	3.91 3.42
Stephenson	39 24 30.73	76 07 58.15	239 09 33 277 54 42	Bare Point	59 11 44 97 58 29	5749.5 8634.4	6287.5 9442.3	3.57 5.36
Howell's Point	39 22 15.52	76 06 20.95	200 09 20 150 51 05	Bare Point	20 10 29 330 50 03	7580.1 4774.5	8289.4 5221.3	4.71 2.97

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Taylor's Island.....	39 22 44.03	76 10 15.97	225 03 22 278 51 37	Stephenson..... Howell's Point.....	45 04 49 98 54 06	4658.9 5694.1	5094.8 6226.9	2.90 3.54
Abbey Island.....	39 20 51.21	76 13 17.41	231 17 35 283 43 31	Taylor's Island..... Plum Point.....	51 19 30 103 46 10	5565.5 6180.6	6086.3 6758.3	3.46 3.84
Plum Point.....	39 20 03.59	76 09 06.74	224 16 47 191 15 56	Howell's Point..... Stephenson	44 18 32 11 16 40	5684.6 8400.3	6216.5 9186.3	3.53 4.60
Lego's Point.....	39 20 06.62	76 14 55.92	288 26 33 239 45 05	Worton Point	108 29 08	6163.6	6740.3	3.82
				Abbey Island	59 46 07	2730.7	2986.2	1.70
<i>Sassafras River.</i>								
Canby	39 22 04.75	76 03 22.23	167 25 05 124 18 36	Bare Point	347 24 21	7631.3	8345.4	4.74
				Stephenson	304 15 41	7991.8	8739.6	4.97
Grove Point	39 23 28.65	76 02 06.64	144 28 31 102 51 12	Bare Point	324 26 59	5972.9	6531.8	3.71
				Stephenson	282 47 29	8626.2	9433.5	4.74
Goldsbrough	39 22 01.04	75 59 45.41	91 16 48 128 39 33	Canby	271 14 31	5190.7	5676.4	3.23
				Grove Point	308 38 04	4326.4	4731.2	2.69
Old Orchard Point	39 23 03.82	75 59 51.71	355 33 22 70 08 26	Goldsbrough.....	175 33 26	1941.7	2123.4	1.21
				Canby	250 06 13	5357.5	5858.9	3.32
Clarke	39 21 49.85	75 57 31.14	96 08 38 124 09 15	Goldsbrough.....	276 07 13	3232.5	3535.0	2.01
				Old Orchard Point	304 07 46	4064.5	4444.8	2.53
Cassidy	39 22 51.39	75 57 43.06	62 04 55 351 37 10	Goldsbrough.....	242 03 38	3314.4	3624.5	2.06
				Clarke	171 27 18	1919.0	2093.6	1.23

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

232

2. Dec. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Knight's Island	39 22 18.97	75 56 04.28	66 39 18 112 56 12	Clarke	246 38 23	2264.7	2476.6	1.41
				Cassidy	292 55 09	2566.8	2807.0	1.60
Ferguson.....	39 21 22.48	75 55 50.80	135 35 34 169 31 02	Cassidy	315 34 23	3838.7	4198.0	2.39
				Knight's Island	349 30 54	1771.4	1937.2	1.11
Reasin.....	39 21 33.54	75 54 26.98	121 02 27 80 22 08	Knight's Island	301 01 25	2717.8	2972.1	1.69
				Ferguson	260 21 14	2035.5	2226.0	1.27
Wicker	39 22 10.46	75 54 26.71	53 41 53 0 19 45	Ferguson.....	233 49 59	2498.2	2732.0	1.55
				Reasin	180 19 45	1138.5	1845.0	0.71
Hall	39 22 06.32	75 53 32.82	52 04 07 95 40 17	Reasin	232 03 33	1643.7	1797.5	1.02
				Wicker	275 39 43	1296.1	1417.4	0.81
Hurtz	39 21 32.05	75 53 33.64	133 00 34 181 04 12	Wicker	313 00 01	1736.8	1899.3	1.08
				Hall	1 04 13	1056.8	1155.7	0.66
Maldenburgh	39 21 22.67	75 52 54.42	145 40 43 107 07 55	Hall	325 49 19	1629.7	1782.2	1.01
				Hurtz	287 07 30	982.3	1074.2	0.61
Ford	39 22 04.68	75 52 42.15	50 47 03 12 47 03	Hurtz	230 46 30	1591.0	1739.9	0.99
				Maldenburgh	192 46 55	1328.2	1452.5	0.82
Eldredge.....	39 22 04.14	75 52 03.48	43 38 57 91 01 37	Maldenburgh	223 38 25	1767.2	1932.6	1.10
				Ford	271 01 13	925.8	1012.4	0.58
Gregg	39 21 44.03	75 51 43.49	114 24 25 142 22 14	Ford	294 23 48	1541.8	1686.1	0.96
				Eldredge.....	322 22 01	783.4	856.7	0.49
Briscoe	39 21 50.97	75 50 42.34	101 49 39 81 41 12	Eldredge.....	281 48 47	1984.0	2169.6	1.23
				Gregg	261 40 33	1479.2	1617.6	0.92

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
<i>Bush River.</i>								
Battery	39 21 47.78	76 10 25.31	329 38 19 7 09 06	Plum Point..... Worton Point.....	149 39 09 187 08 49	3723.8 5112.2	4072.2 5590.6	2.31 3.18
Wilson.....	39 22 35.39	76 16 00.88	309 22 16 341 16 24	Abbey Island..... Lego's Point.....	129 23 59 161 17 05	5063.8 4844.9	5537.6 5298.2	3.15 3.01
Elliott	39 22 34.26	76 14 44.01	91 05 47 3 35 21	Wilson..... Lego's Point.....	271 04 58 183 35 13	1849.4 4562.6	2017.6 4989.5	1.14 2.84
Dorney	39 23 31.83	76 15 38.51	323 43 03 17 05 11	Elliott	143 43 37	2204.5	2410.8	1.37
				Wilson.....	197 04 57	1822.6	1993.2	1.32
Fair Point.....	39 24 37.99	76 15 02.15	353 30 34 23 06 45	Elliott	173 39 45	3840.7	4200.1	2.39
				Dorney	293 06 22	2216.8	2434.2	1.38
Chelsea	39 24 43.37	76 13 52.47	49 01 16 84 19 30	Dorney..... Fair Point.....	229 00 09 264 18 46	3361.4 1675.3	3675.9 1832.1	2.09 1.04
Chilby Point.....	39 26 16.25	76 14 00.49	25 57 33 356 10 14	Fair Point..... Chelsea.....	205 56 54 176 10 19	3370.4 2871.1	3685.8 3139.8	2.09 1.79
Kennard	39 26 04.05	76 14 47.44	332 08 52 251 28 27	Chelsea..... Chilby Point.....	152 09 26 71 28 56	2814.5 1184.1	3077.9 1294.9	1.75 0.74
Hollis	39 27 13.45	76 14 31.18	337 24 50 10 17 53	Chilby Point..... Kennard	157 25 10 190 17 43	1910.7 2175.4	2089.5 2379.0	1.19 1.35
Abingdon Cupola.....	39 27 33.22	76 16 23.32	263 12 21 237 58 40	Maulden's Mountain..... Principio	83 25 40 58 11 21	24912.5 27733.6	27243.8 36328.5	15.48 17.23

S. Dec. 3.

333

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

334

S. Dec. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Birch Head.....	39 25 10.68	76 18 00.05	317 49 31 6 25 04	Worton Point.....	137 54 03	15276.2	16705.6	9.49
				Carroll's Island.....	186 24 28	11996.7	13119.2	7.45
Gunpowder River.								
Pool's Island Light.....	39 17 22.50	76 15 41.20	176 17 23 345 18 47	Osborne's Ruin.....	356 16 50	19442.7	21262.0	12.08
				Mitchell's Bluff.....	165 19 42	8170.5	8935.1	5.08
Pool's Island Signal.....	39 16 23.76	76 16 01.39	337 14 26 60 41 06	Mitchell's Bluff.....	157 15 34	6606.4	7224.6	4.10
				Black Marsh.....	240 35 22	14898.4	16401.8	9.32
Rickett's Point.....	39 18 11.58	76 17 26.18	114 58 06 46 58 03	Carroll's Island.....	294 57 09	2374.0	2596.1	1.48
				Miller's Island.....	226 55 52	6768.0	7401.3	4.21
Spry's Island.....	39 17 39.58	76 19 16.85	319 19 00 32 16 16	Mitchell's Bluff.....	139 22 11	11112.6	12152.9	6.90
				Miller's Island.....	212 15 15	4297.1	4699.4	2.67
Grace's Quarter.....	39 20 45.98	76 19 58.95	338 09 13 322 26 51	Carroll's Island.....	158 09 53	4050.3	2429.3	2.52
				Rickett's Point.....	142 28 28	6004.7	6566.6	3.73
Maxwell's Point.....	39 21 20.64	76 18 31.26	7 00 27 63 02 10	Carroll's Island.....	187 00 12	4864.3	5319.5	3.02
				Grace's Quarter.....	243 01 15	2355.7	2576.1	1.46
Harewood.....	39 22 17.78	76 20 01.37	358 49 52 309 14 23	Grace's Quarter.....	178 49 53	2831.1	3096.0	1.76
				Maxwell's Point.....	129 15 20	2785.1	3045.7	1.73
Piny Point.....	39 23 16.13	76 19 41.93	334 35 35 14 30 13	Maxwell's Point.....	154 36 19	2942.5	4311.4	2.45
				Harewood.....	194 30 00	1858.5	2032.4	1.16
Taylor's Mount.....	39 23 38.78	76 22 07.69	309 33 36 281 18 50	Harewood.....	129 34 56	3921.1	4288.0	2.43
				Piny Point.....	101 20 23	3556.8	3889.6	2.21

United States Coast Survey.—Geographical Positions. Section III.—Head of Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
<i>Middle River.</i>								
Carroll's Lower Island.....	39 17 51.83	76 20 28.97	8 01 24 262 04 07	Miller's Island..... Rickett's Point.....	188 01 09 82 06 03	4050.9 4421.5	4430.2 4835.2	2.52 2.75
Holly Point North.....	39 17 08.18	76 22 43.85	247 22 59 179 18 08	Carroll's Lower Island..... Thick Neck Point.....	67 24 25 359 18 08	3500.8 1250.0	3828.5 1367.0	2.18 0.78
Thick Neck Point.....	39 17 48.72	76 22 44.49	325 34 36 263 17 57	Miller's Island..... Carroll's Lower Island.....	145 35 46 88 19 23	4746.2 3248.2	5190.3 3550.2	2.95 2.02
Piney Point.....	39 18 34.51	76 24 51.54	294 52 48 311 01 10	Thick Neck Point..... Holly Point North.....	114 54 09 132 02 31	3355.4 4055.3	3669.4 4434.9	2.08 2.52
<i>Back River.</i>								
Holly Point South.....	39 16 33.18	76 22 40.86	232 29 21 301 25 03	Carroll's Lower Island..... Miller's Island.....	52 30 44 121 26 11	3983.6 3042.2	4356.5 3326.9	2.48 1.90
Hart's Island.....	39 14 38.53	76 22 34.10	231 18 47 177 22 43	Miller's Island..... Holly Point South.....	51 19 51 357 22 39	3118.6 3538.9	3410.4 3870.0	1.93 2.20
Rocky Point.....	39 14 53.05	76 23 44.78	206 23 32 284 47 48	Holly Point South..... Hart's Island.....	26 24 13 104 48 33	3446.7 1752.8	3769.3 1916.9	2.14 1.69
Townsend.....	39 13 52.64	76 24 35.72	244 06 26 213 14 56	Hart's Island..... Rocky Point.....	64 07 43 33 15 28	3241.6 2227.6	3544.9 2436.1	2.01 1.39
Provin.....	39 14 47.86	76 24 38.50	275 29 55 357 45 25	Hart's Island..... Townsend.....	95 31 14 177 45 27	2996.6 1704.0	3277.1 1863.6	1.86 1.06

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lynch.....	39 15 06.00	76 26 33.39	308 42 51 281 28 30	Townsend..... Provin.....	128 44 06 101 29 43	3616.5 2810.7	3954.9 3073.6	2.25 1.75
Porter.....	39 15 15.96	76 25 51.09	324 52 16 296 27 36	Townsend..... Provin.....	144 53 04 116 28 22	3141.1 1944.2	3435.2 2126.1	1.95 1.21
Stansbury's Point.....	39 16 13.92	76 26 42.96	353 45 05 325 10 32	Lynch..... Porter.....	173 45 11 145 11 05	2106.6 2177.1	2303.7 2380.8	1.31 1.25
Johnson.....	39 16 27.02	76 26 00.19	17 40 34 68 29 29	Lynch..... Stansbury's Point.....	197 40 13 248 29 02	2621.9 1101.8	2867.2 1205.0	1.63 0.68
Woodyard.....	39 17 28.44	76 27 33.86	329 45 26 308 41 11	Stansbury's Point..... Johnson.....	149 46 01 128 42 13	2659.8 3029.3	2908.7 3312.9	1.65 1.88
<i>Patapsco River.</i>								
Bodkin, (signal).....	39 08 01.92	76 25 09.28	266 24 01 0 00 04	Swan Point..... Gibson's Island.....	86 29 29 180 00 02	12505.4 6337.2	13675.5 6930.2	7.77 3.94
North Point.....	39 11 40.81	76 26 20.70	292 46 43 345 44 25	Swan Point..... Bodkin.....	112 52 56 165 45 10	15393.5 6963.5	16837.2 7615.1	9.57 4.33
North Point Lower Light....	39 11 35.93	76 26 12.48	292 32 45 226 08 11	Swan Point..... Black Marsh.....	112 38 53 46 08 53	15155.4 2194.5	16573.5 2399.8	10.42 1.37
North Point Upper Light....	39 11 46.08	76 26 35.86	292 48 37 343 15 33	Swan Point..... Bodkin.....	112 55 00 163 16 28	15794.6 7217.6	17272.5 7893.0	9.81 4.48
Bodkin Light.....	39 08 01.89	76 25 09.58	239 06 02 266 24 04	Mitchell's Bluff..... Swan Point.....	59 12 56 86 29 32	18302.6 12512.0	20015.3 13682.8	11.37 7.77

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Rock Point Bank	39 08 39.13	76 26 59.05	201 09 55 293 30 30	Black Marsh..... Bodkin	21 11 06 113 31 39	7477.2 2874.8	8176.8 3143.6	4.65 1.79
Rock Point.....	39 09 59.51	76 28 19.07	308 29 30 222 16 31	Bodkin..... North Point.....	128 31 30 42 17 46	5823.2 4222.0	6368.2 4617.1	3.62 2.62
Ridgely's Steeple House.....	39 12 27.33	76 25 22.37	357 48 08 300 02 15	Bodkin..... Swan Point.....	177 48 16 120 07 52	8190.0 14779.6	8956.3 16162.5	5.09 9.18
Sparrow Point	39 12 35.73	76 29 06.86	293 00 07 346 36 12	North Point..... Rock Point.....	113 01 52 166 36 42	4331.3 4951.7	4736.6 5415.0	2.69 3.08
Hawkins' Point.....	39 12 32.13	76 31 39.30	314 23 13 268 15 04	Rock Point..... Sparrow Point	134 25 20 88 16 40	6725.8 3658.6	7355.1 4000.9	4.18 2.27
Sollers' Point.....	39 13 36.71	76 30 30.42	313 10 11 39 41 24	Sparrow Point..... Hawkins' Point	133 11 04 219 40 40	2748.3 2587.6	3005.5 2829.7	1.71 1.61
Lazaretto.....	39 15 40.63	76 33 55.83	330 35 48 307 47 15	Hawkins' Point..... Sollers' Point.....	150 37 14 127 49 25	6671.3 6233.9	7295.5 6817.2	4.15 3.87
Fort McHenry, (flag-staff) ..	39 15 44.34	76 34 28.05	304 36 42 325 39 40	Sollers' Point..... Hawkins' Point	124 39 12 145 41 27	6924.7 7176.4	7572.7 7848.0	4.30 4.46
Snow Hill	39 12 20.86	76 35 08.31	250 38 19 195 44 53	Sollers' Point..... Lazaretto	70 41 15 15 45 39	7064.1 6400.8	7725.1 6999.7	4.39 3.98
Rosanne	39 17 27.49	76 42 45.82	232 16 16 318 11 22	Finlay	52 23 37	21056.1	23026.3	13.08
				Linstid	138 20 10	30128.6	32947.7	18.72
Washington Monument, Baltimore.	39 17 47.80	76 36 38.58	334 00 43 85 57 41	Linstid	154 05 39	25699.1	28103.8	15.96
				Rosanne.....	265 53 48	8821.7	9647.2	5.48

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

338

2. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
CHESTER RIVER.								
Carville	38 59 44.07	76 16 57.56	127 21 32 182 23 23	Gibson's Island	307 16 22	14868.8	16260.1	9.24
Wright's Mill.....	38 58 09.21	76 14 18.35	127 22 08 170 36 40	Gibson's Island	307 16 05	19689.1	21531.4	12.23
Wickes	39 01 47.46	76 14 17.47	45 21 55 0 11 00	Swan Point.....	350 35 17	19310.0	21116.9	12.00
Wilson	39 05 35.00	76 13 49.27	5 31 33 22 43 34	Carville.....	225 20 14	5413.9	5920.5	3.37
Cedar Point	39 00 46.42	76 12 42.96	25 21 03 72 36 01	Wright's Mill.....	180 11 00	6729.5	7359.2	4.18
Hail Point.....	39 00 43.91	76 11 36.45	39 15 31 76 35 55	Wickes	185 31 15	7048.7	7708.3	4.38
Lord's Gift	38 59 38.49	76 10 03.64	91 01 48 132 06 32	Carville.....	202 41 35	11730.0	12827.6	7.29
Piny Point	39 02 41.87	76 10 46.65	349 37 59 18 14 03	Wright's Mill.....	205 20 03	5363.2	5865.0	3.33
Eastern Neck Inlet.....	39 03 24.88	76 12 14.41	349 34 40 302 08 49	Carville.....	252 33 20	6420.3	7021.1	3.99
Harris.....	39 05 38.14	76 10 55.61	357 44 04 24 45 30	Wright's Mill.....	219 13 49	6158.6	6734.9	3.83
				Carville.....	256 32 32	7943.2	8686.4	4.94
				Hail Point	270 57 28	9961.5	10893.6	6.19
				Lord's Gift	312 05 34	3009.1	3290.7	1.87
				Hail Point	169 38 26	5748.3	6286.2	3.57
				Piny Point	198 13 32	3829.4	4187.8	2.38
				Hail Point	169 35 04	5046.8	5519.0	3.14
				Piny Point	122 09 45	2492.3	2725.5	1.51
				Piny Point	177 44 09	5439.6	5948.6	3.38
				Eastern Neck Inlet.....	204 44 40	4524.5	4947.9	2.81

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.		Distance. Metres.	Distance. Yards.	Distance. Miles
					° ' "	° ' "			
Lower Spaniard's Point	39 05 30.41	76 08 25.77	54 52 03 93 48 31	Eastern Neck Inlet..... Harris	234 49 38 273 46 57		6721.6 3608.3	7350.5 3945.9	4.18 2.24
Nichols	39 06 16.69	76 09 29.75	60 03 36 312 52 10	Harris	240 02 42		2380.7	2603.5	1.48
				Lower Spaniard's Point.....	132 52 50		2097.7	2294.0	1.30
Upper Spaniard's Point.	39 05 49.23	76 07 58.39	48 34 17 111 06 14	Lower Spaniard's Point..... Nichols	228 34 00 291 05 16		877.3 2352.6	959.4 2572.7	0.55 1.46
Emory.....	39 06 12.99	76 06 29.66	91 31 53 71 03 06	Nichols..... Upper Spaniard's Point.....	271 29 59 251 02 11		4328.4 2254.3	4733.5 2465.2	2.69 1.40
Deep Point	39 06 28.35	76 06 50.03	52 43 05 314 03 43	Upper Spaniard's Point..... Emory	233 42 23 134 03 56		2037.7 681.1	2228.4 744.8	1.27 0.42
Commegys	39 06 58.43	76 06 18.20	39 30 53 11 07 15	Deep Point..... Emory	219 30 33 191 07 08		1202.0 1427.9	1314.5 1561.6	0.75 0.89
Mummey.....	39 06 47.62	76 05 59.28	34 21 08 126 16 02	Emory..... Commegys	214 20 49 306 15 50		1293.3 563.4	1414.2 616.1	0.80 0.35
Smith	39 07 21.76	76 05 17.25	43 48 27 63 50 02	Mummey..... Commegys	223 48 01 243 49 24		1458.7 1631.2	1595.2 1783.8	0.91 1.01
Shell Point.....	39 08 01.21	76 04 53.79	46 20 06 24 52 01	Commegys	226 19 13		2803.1	3065.4	1.74
				Smith.....	204 51 46		1340.5	1468.0	0.83
Holliday	39 07 40.26	76 04 27.16	64 38 55 135 17 50	Smith..... Shell Point	244 38 23 315 17 33		1331.4 908.9	1456.0 993.9	0.83 0.57
Gauld	39 08 37.38	76 03 31.38	60 35 57 37 15 27	Shell Point	240 35 05		2271.5	2484.0	1.41
				Holliday	217 14 52		2212.9	2420.0	1.37

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Vickers	39 09 16.73	76 04 14.76	5 43 20 319 21 26	Holliday	185 43 12	2989.6	3269.3	1.86
				Gauld	139 21 53	1598.9	1748.5	0.99
S. Merritt	39 09 44.51	76 03 04.90	17 04 59 62 57 09	Gauld	197 04 43	2165.3	2367.9	1.35
				Vickers	242 56 25	1883.2	2059.4	1.17
Wilmer	39 09 23.40	76 02 36.23	85 02 31 133 24 40	Vickers	265 01 29	2374.3	2596.5	1.48
				S. Merritt	313 24 22	947.3	1035.9	0.59
Harrison	39 10 08.61	76 01 36.07	70 47 38 46 00 59	S. Merritt	250 46 42	2258.0	2469.3	1.40
				Wilmer	226 00 21	2007.2	2195.0	1.25
Clements	39 10 54.92	76 02 00.57	16 52 54 337 37 30	Harrison	196 52 32	1544.1	1688.6	0.96
				Wilmer	157 37 46	2949.0	3224.9	1.83
J. W. Merritt	39 10 42.46	76 03 25.43	334 09 09 259 18 53	Wilmer	154 09 40	2708.8	2962.3	1.68
				Clements	79 19 46	2072.6	2266.5	1.29
Clarke	39 11 19.45	76 04 02.62	284 28 31 321 57 36	Clements	104 29 48	3025.1	3308.2	1.88
				J. W. Merritt	141 58 00	1448.3	1583.8	0.90
Primrose, (1)	39 11 35.78	76 03 34.35	352 35 11 53 25 37	J. W. Merritt	172 35 17	1658.0	1813.1	1.03
				Clarke	233 25 19	844.8	923.9	0.53
Chestertown, (1)	39 12 06.67	76 03 43.47	17 31 32 347 04 14	Clarke	197 31 20	1526.8	1669.8	0.96
				Primrose, (1)	167 04 20	977.3	1068.8	0.61
Chestertown, (2)	39 12 39.99	76 03 11.25	15 38 46 36 57 51	Primrose, (1)	195 38 31	2056.0	2248.4	1.28
				Chestertown, (1)	216 57 30	1285.6	1405.9	0.80
Wiley's Point	39 12 46.70	76 02 25.30	56 39 28 79 22 28	Chestertown, (1)	236 38 38	2244.9	2455.0	1.40
				Chestertown, (2)	259 21 59	1121.4	1226.3	0.70

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Hopewell	39 13 15.34	76 02 10.46	53 13 48 21 57 55	Chestertown, (2)..... Wiley's Point.....	233 13 09 201 57 46	1820.6 952.2	1991.0 1041.3	1.13 0.59
Primrose, (2).....	39 13 25.14	76 01 15.48	54 43 01 77 05 33	Wiley's Point..... Hopewell	234 42 17 257 04 58	2051.9 1352.9	2243.6 1479.5	1.28 0.84
Wallis	39 14 03.54	76 00 51.79	51 46 54 25 38 36	Hopewell	231 46 04	2401.8	2626.5	1.49
				Primrose, (2).....	205 38 21	1313.1	1436.0	0.82
Opossum Point.....	39 14 09.35	76 00 09.97	49 03 47 79 52 18	Primrose, (2)..... Wallis	229 03 06 259 51 52	2080.0 1018.6	2274.6 1113.9	1.29 0.63
Longford	39 14 34.59	75 59 38.98	47 13 49 61 15 56	Primrose, (2)..... Wallis	227 12 48 241 15 11	3152.8 1991.3	3447.8 2177.6	1.96 1.24
Double Creek Point	39 14 10.41	75 59 09.28	88 43 11 136 19 23	Opossum Point	268 42 32	1455.8	1592.0	0.91
				Longford.....	316 19 04	1031.0	1127.5	0.64
Double Creek Marsh.....	39 14 31.18	75 58 34.15	73 40 55 52 45 44	Opossum Point	253 39 54	2394.5	2618.6	1.49
				Double Creek Point.....	232 45 22	1058.3	1157.3	0.65
Walker	39 14 46.72	75 58 42.69	29 40 24 336 52 08	Double Creek Point..... Double Creek Marsh	209 40 07 156 52 13	1288.5 520.9	1409.1 569.7	0.80 0.32
Muddy Marsh.....	39 14 50.17	75 57 42.47	59 38 45 84 57 38	Double Creek Marsh	239 38 19	1158.2	1266.6	0.72
				Walker	264 57 07	1208.7	1321.8	0.75
Beckington's Marsh	39 14 32.44	75 57 49.67	109 06 46 172 58 24	Walker	289 06 13	1345.6	1471.5	0.84
				Muddy Marsh.....	352 58 22	550.8	602.4	0.34
Thomson's Marsh	39 14 20.57	75 57 00.94	126 27 41 107 24 02	Muddy Marsh..... Beckington's Marsh	306 27 08 287 23 31	1536.0 1224.0	1679.7 1338.5	0.96 0.76

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Kent Island, (3).....	38 57 02.03	76 21 08.94	157 35 45 201 06 09	Gibson's Island..... Kent Island, (1).....	337 33 11 21 07 39	15156.4 9496.6	16574.6 10385.2	9.42 5.90
Thomas' Point.....	38 54 25.09	76 26 52.07	232 54 02 278 01 47	North Base..... South Base.....	52 58 16 98 05 04	12179.7 7609.4	13319.4 8321.4	7.57 4.73
Hackett's Point.....	38 59 02.82	76 25 09.22	240 47 55 16 09 13	Kent Island, (1)..... Thomas' Point.....	60 51 51 196 08 13	10537.3 8912.9	11523.3 9746.9	6.55 5.54
Price's Point.....	38 54 29.21	76 21 39.36	149 05 52 89 04 52	Hackett's Point..... Thomas' Point.....	329 03 40 269 01 36	9834.5 7536.9	10754.7 8242.1	6.11 4.68
Bloody Point.....	38 50 52.47	76 22 29.72	136 03 36 192 27 58	Thomas' Point..... South Base.....	316 00 51 12 28 30	9108.4 5622.2	9960.7 6148.3	5.66 3.49
Greenbury's Point.....	38 58 21.79	76 26 56.12	313 12 21 243 48 02	Price's Point..... Hackett's Point.....	133 15 40 63 49 09	10469.7 2867.0	11449.4 3135.3	6.51 1.78
Tallis' Point.....	38 56 20.71	76 26 44.00	3 09 28 295 04 36	Thomas' Point..... Price's Point.....	183 09 23 115 07 47	3567.6 8103.0	3901.4 8861.2	2.22 5.04
Annapolis State-house.....	38 58 40.18	76 29 09.41	248 39 59 305 29 31	Kent Island, (1)..... Price's Point.....	68 46 31 125 34 14	16075.4 13317.5	17579.6 14563.6	9.99 8.27
<i>Magothy and Severn Rivers.</i>								
LINSTID.....	39 05 18.39	76 28 49.96						
Persimon Point.....	39 02 51.88	76 25 58.89	200 18 52 137 42 28	Gibson's Island..... Linstd Linstd	20 19 23 317 40 41	3435.9 6108.8	3757.4 6680.4	2.14 3.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Pettibone	39 02 25.08	76 24 44.55	171 39 24 114 49 36	Gibson's Island	351 39 09	4092.1	4475.0	2.54
Stony Point	39 04 06.71	76 25 45.44	7 58 57 334 57 39	Persimon Point	294 48 49	2479.3	2711.1	1.54
Hickory Point	39 05 16.83	76 27 09.75	91 09 29 339 08 04	Persimon Point	187 58 48 154 58 17	2329.9 3457.4	2547.9 3780.9	1.45 2.15
Strawberry Plains	39 03 14.54	76 29 42.62	198 20 09 224 14 59	Linstid	271 08 26	2408.6	2634.0	1.49
Aisquith Hill	39 02 37.32	76 30 53.79	210 55 43 236 08 55	Persimon Point	159 08 49	4782.9	5230.4	2.97
Shop Hill	39 02 58.16	76 34 23.00	241 36 02 277 15 57	Linstid	18 20 42	4023.0	4399.4	2.50
Brewer's Hill	39 01 32.69	76 31 46 07	212 14 56 124 56 55	Hickory Point	44 16 37	5264.8	5757.4	3.27
Watkins, (1)	39 01 05.89	76 29 40.72	148 04 30 105 20 29	Linstid	30 57 01	5790.1	6331.9	3.60
Wells' Hill	38 59 35.62	76 30 15.61	196 46 59 148 55 34	Strawberry Plains	56 09 39	2060.5	2253.3	1.28
Brice's Point	38 59 49.58	76 28 46.90	151 11 12 78 36 51	Linstid	61 39 32	9098.3	9949.6	5.65
Frog Pond Hill	38 57 00.16	76 29 22.61	165 06 31 189 20 47	Aisquith Hill	97 18 09	5071.3	5545.8	3.15
				Aisquith Hill	32 15 29	2356.5	2578.9	1.47
				Shop Hill	304 55 17	4602.9	5033.6	2.86
				Brewer's Hill	328 03 44	3322.1	3632.9	2.06
				Watkins, (1)	285 19 10	3126.3	3418.8	1.94
				Brewer's Hill	16 47 21	2907.2	3179.2	1.81
				Watkins, (1)	328 54 37	4215.0	4609.4	2.62
				Wells' Hill	331 10 38	2685.8	2937.1	1.67
				Brice's Point	258 35 55	2177.5	2381.3	1.35
				Wells' Hill	345 05 58	4960.5	5424.7	3.08
				Brice's Point	9 21 09	5294.3	5789.7	3.29

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Beaumont	38 59 15.20	76 27 50.64	100 14 53	Well's Hill.....	280 13 21	3544.7	3876.4	2.20
			28 00 35	Frog Pond Hill.....	207 59 37	4716.0	5157.3	2.93
Ridout.....	39 00 22.90	76 25 52.18	337 21 29	Hackett's Point.....	187 21 56	2677.2	2927.7	1.66
			65 11 48	Taylor	245 10 42	2784.4	3044.9	1.73
Thompson's Hill.....	39 01 48.44	76 33 04.57	138 45 00	Shop Hill.....	318 44 10	2859.9	3127.5	1.78
			244 23 14	Aisquith Hill.....	64 24 36	3487.4	3813.7	2.17
Worthington.....	39 01 10.73	76 34 32.52	183 57 23	Shop Hill.....	3 57 29	3320.3	3631.0	2.06
			241 12 12	Thompson's Hill.....	61 13 08	2413.8	2639.7	1.50
Cooke's Bank.....	39 03 45.06	76 32 53.55	56 05 35	Shop Hill.....	236 04 38	2591.5	2834.0	1.61
			4 13 04	Thompson's Hill.....	184 12 58	3615.6	3953.9	2.25
Miller's Hill.....	39 03 04.10	76 31 57.89	34 30 57	Thompson's Hill.....	214 30 15	2830.8	3095.7	1.76
			354 14 55	Brewer's Hill.....	174 15 02	2832.8	3097.7	1.77
Mount Pleasant.....	39 02 26.87	76 35 01.21	255 23 09	Miller's Hill.....	75 25 04	4555.0	4981.2	2.83
			343 37 50	Worthington	163 38 08	2447.5	2676.5	1.52
South River.								
Horse-shoe Point.....	38 50 20.72	76 28 54.22	201 20 00	Thomas' Point.....	21 21 17	8090.0	8847.0	5.03
			263 56 23	Bloody Point.....	84 00 24	9323.3	10195.7	5.79
Sanders' Point.....	38 53 07.62	76 29 01.33	232 30 22	Thomas' Point.....	52 31 43	3925.2	4292.6	2.44
			358 05 32	Horse-shoe Point.....	178 05 36	5149.3	5631.1	3.20
Fishing Creek.....	38 54 39.46	76 27 51.49	287 11 40	Thomas' Point.....	107 12 17	1498.6	1638.8	0.93
			30 43 44	Sanders' Point.....	210 43 00	3294.0	3602.2	2.05

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Turkey Point.....	38 54 28.37	76 29 21.94	348 43 22 261 04 32	Sanders' Point..... Fishing Creek.....	168 43 35 81 05 29	2538.8 2205.6	2776.4 2412.0	1.58 1.37
Hill's Point.....	38 55 21.32	76 29 44.30	295 24 03 341 44 23	Fishing Creek..... Turkey Point.....	115 25 14 161 44 37	3008.4 1719.3	3289.9 1880.2	1.87 1.07
Deep Point.....	38 55 09.24	76 30 14.01	315 07 40 242 29 44	Turkey Point..... Hill's Point.....	135 08 13 62 30 03	1778.1 806.8	1944.5 882.3	1.11 0.50
Switcher's Point.....	38 55 51.36	76 30 39.03	305 05 50 335 07 05	Hill's Point..... Deep Point.....	125 06 24 155 07 20	1610.9 1431.8	1757.1 1565.8	1.00 0.87
Brewer's Point.....	38 55 53.44	76 31 21.77	309 52 02 273 33 33	Deep Point..... Switcher's Point.....	129 52 45 93 34 20	2126.2 1031.3	2325.2 1127.8	1.32 0.64
Ferry.....	38 56 40.95	76 31 37.52	317 20 37 345 28 48	Switcher's Point..... Brewer's Point.....	137 21 15 165 28 58	2079.0 1513.2	2273.5 1654.8	1.29 0.94
Gingawill Creek.....	38 56 59.67	76 32 28.76	321 41 21 295 04 29	Brewer's Point..... Ferry.....	141 42 04 115 05 02	2602.5 1362.1	2846.0 1489.6	1.62 0.84
Lee.....	38 56 45.08	76 32 56.10	273 50 35 235 38 13	Ferry..... Gingawill Creek.....	93 51 24 55 38 30	1896.3 797.3	2073.7 871.9	1.16 0.50
Tucker's Point.....	38 57 17.34	76 33 15.93	295 37 08 334 21 18	Gingawill Creek..... Lee.....	115 37 38 154 21 31	1259.6 1103.4	1377.5 1206.7	0.78 0.69
Holland's Point.....	38 56 59.97	76 33 31.86	298 03 59 215 36 27	Lee..... Tucker's Point.....	118 04 22 35 36 37	975.8 658.7	1067.1 720.3	0.60 0.41
Boyd's Point.....	38 57 14.64	76 33 46.78	263 36 18 321 32 58	Tucker's Point..... Holland's Point.....	83 36 37 141 33 07	747.3 577.5	817.2 631.5	0.47 0.36

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Warehouse.	38 57 09.60	76 34 02.58	291 53 23 247 49 08	Holland's Point..... Boyd's Point.....	111 53 42 67 49 18	797.1 410.8	871.7 494.3	0.50 0.26
Fox Den	38 57 33.51	76 34 24.11	302 55 27 324 53 24	Boyd's Point..... Warehouse	122 55 50 144 53 38	1070.6 900.9	1170.8 985.2	0.67 0.56
Gravelly Point.....	38 57 26.83	76 34 39.01	301 12 22 240 09 10	Warehouse..... Fox Den.....	121 12 45 60 09 19	1025.3 413.5	1121.3 452.2	0.63 0.25
Beard's Point.....	38 57 37.84	76 35 00.35	303 27 31 278 42 48	Gravelly Point..... Fox Den.....	123 27 45 98 43 11	615.9 882.7	673.5 965.3	0.38 0.55
Weedon	38 57 44.70	76 34 49.39	335 36 42 51 18 38	Gravelly Point..... Beard's Point.....	155 36 49 231 18 31	605.0 338.2	661.6 369.9	0.38 0.21
Old Woman Point.....	38 57 45.70	76 35 19.36	297 53 43 272 26 36	Beard's Point..... Weedon	117 53 54 92 26 55	517.7 722.1	566.2 789.7	0.32 0.45
Nicholson	38 57 43.50	76 35 29.83	283 49 36 254 58 16	Beard's Point..... Old Woman Point.....	103 49 54 74 58 23	730.6 260.7	799.0 285.1	0.45 0.16
Wood-landing.	38 58 16.29	76 35 42.21	343 33 55 329 45 06	Nicholson..... Old Woman Point.....	163 34 03 149 45 20	1053.9 1091.8	1152.5 1194.0	0.66 0.68
<i>West River.</i>								
Gowan.....	38 52 55.90	76 29 10.42	230 28 15 355 19 51	Thomas' Point..... Horse-shoe	50 29 42 175 20 01	4320.8 4800.8	4725.1 5250.0	2.68 2.98
Cutts' Point	38 51 12.01	76 29 33.11	189 41 30 213 05 34	Gowan..... Thomas' Point.....	9 41 44 33 07 15	3249.4 7106.8	3553.4 7771.8	2.02 4.42

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

348

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Dutchman's Point.....	38 52 06.94	76 30 15.42	226 03 42 328 56 50	Gowan..... Cutts' Point.....	46 04 23 148 57 16	2175.3 1977.0	2378.9 2162.0	1.35 1.23
Cedar Point.....	38 51 01.14	76 31 07.59	261 37 29 211 47 49	Cutts' Point..... Dutchman's Point.....	81 38 28 31 48 22	2302.4 2387.1	2517.8 2610.5	1.43 1.48
Maxcy.....	38 51 07.28	76 31 53.94	267 31 48 332 14 13	Cutts' Point..... Dutchman's Point.....	87 33 16 52 15 15	3398.5 3004.4	3716.5 3285.5	2.11 1.87
Rhode River.....	38 52 09.25	76 30 51.90	312 53 27 274 36 49	Cutts' Point..... Dutchman's Point.....	132 54 17 94 37 12	2592.6 882.3	2835.2 964.9	1.61 0.56
MARRIOTT.....	38 52 24.15	76 36 16.41	.....	.....	.....	.....	.....	.....
Poplar Island, Herring Bay.	.....	.....	.....	.....	.....	.....	.....	.....
POPLAR ISLAND, (1).....	38 45 25.66	76 22 53.29	.....	.....	.....	.....	.....	.....
Franklin's Point.....	38 49 02.61	76 29 30.91	231 58 34 201 02 56	South Base..... Thomas' Point.....	52 03 29 21 04 35	14423.8 10655.3	15773.4 11652.3	8.96 6.62
Poplar Island, (2).....	38 46 23.23	76 22 57.02	159 08 25 117 22 33	Thomas' Point..... Franklin's Point.....	339 05 57 297 18 27	15902.0 10699.6	17390.0 10700.8	9.88 6.65
Holland's Point North.....	38 43 42.52	76 31 12.42	193 55 47 255 10 58	Franklin's Point..... Poplar Island, (1).....	13 56 51 75 16 10	10170.1 12465.4	11121.7 13631.8	6.32 7.75
Paca's Island.....	38 46 30.91	76 31 51.01	349 48 49 271 00 22	Holland's Point North..... Poplar Island, (2).....	169 49 13 91 05 56	5274.6 12890.7	5768.1 14096.9	3.28 8.01
Weems' Windmill.....	38 46 10.43	76 34 00.16	258 32 12 318 22 09	Paca's Island..... Holland's Point North.....	78 33 33 138 23 54	3180.7 6099.5	3478.3 6670.2	1.98 3.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Fairhaven	38 45 12.64	76 33 35.42	308 47 55 226 14 08	Holland's Point North	128 49 24	4432.7	4847.5	2.76
Owens' Windmill	38 42 59.53	76 32 49.15	192 09 17 164 46 40	Paca's Island	46 15 13	3489.6	3816.1	2.17
Holland's Point	38 42 53.42	76 31 12.30	192 07 34 248 40 40	Paca's Island	12 09 53	6666.9	7290.7	4.14
Eastern Bay.				Fairhaven	344 46 11	4253.3	4651.3	2.64
Wade's Point	38 49 37.78	76 17 43.01	123 50 49 43 56 57	Franklin's Point	12 08 38	11644.3	12733.9	7.24
Poplar Island, (3)	38 46 50.21	76 22 04.74	230 41 27 153 44 18	Poplar Island, (1)	68 45 52	12932.3	14142.4	8.04
Lowe's Point	38 46 35.99	76 19 45.77	207 50 54 97 27 35	Thomas' Point	303 45 04	15927.1	17417.4	9.90
Long Point, (Kent Island)	38 51 13.56	76 19 56.58	20 51 09 312 30 45	Poplar Island, (3)	223 53 43	10793.8	11803.8	6.71
Turkey Point	38 54 04.79	76 17 14.77	4 43 46 36 28 00	Wade's Point	50 44 11	8158.6	8922.0	5.07
Bodkin Island	38 53 38.89	76 16 30.16	13 17 41 48 00 35	Long Point, (Kent Island)	333 41 17	15643.3	17107.0	9.72
Tilghman's Point	38 51 51.69	76 14 50.74	80 58 07 144 04 19	Wade's Point	27 52 11	6339.1	6932.3	3.94
				Long Point, (Kent Island)	277 26 08	3382.2	3698.7	2.10
				Wade's Point	200 49 49	8688.7	9501.7	5.40
				Long Point, (Kent Island)	132 32 09	4370.7	4779.7	2.72
				Wade's Point	184 43 28	8262.1	9035.2	5.13
				Long Point, (Kent Island)	216 26 19	6563.2	7177.3	4.08
				Wade's Point	193 16 55	7639.8	8354.7	4.75
				Long Point, (Kent Island)	227 58 25	6695.9	7322.4	4.16
				Long Point, (Kent Island)	260 54 55	7466.3	8164.9	4.64
				Bodkin Island	324 03 17	4082.8	4464.8	2.54

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Yards.	Metres.	Miles.
Parson's Point.....	38 55 19.34	76 15 08.31	32 29 34 356 12 58	Bodkin Island..... Tilghman's Point.....	212 28 43 176 13 09	4015.2 7017.2	3671.6 6416.8	2.28 3.98
Parson's Island.....	38 54 01.85	76 14 54.95	358 33 08 72 51 18	Tilghman's Point..... Bodkin Island.....	178 33 11 252 50 18	4390.3 2625.8	4014.6 2401.1	2.49 1.49
Bryan	38 55 53.50	76 12 30.40	54 19 18 24 24 30	Bodkin Island..... Tilghman's Point.....	234 16 47 204 23 02	7777.9 8953.1	7112.4 8187.0	4.42 5.09
<i>Wye River.</i>								
Bennett's Point.....	38 51 47.82	76 11 47.88	116 44 49 91 34 02	Bodkin Island	296 41 52	8329.6	7616.9	4.73
				Tilghman's Point.....	271 32 07	4822.3	4409.7	2.74
Mouth of Wye River.....	38 50 37.68	76 11 35.00	115 49 33 171 49 59	Tilghman's Point..... Bennett's Point.....	295 47 30 351 49 51	5732.5 2389.5	5242.0 2185.0	3.26 1.36
E. Lloyd.....	38 51 23.88	76 09 43.44	103 50 15 62 06 23	Bennett's Point..... Mouth of Wye River.....	283 48 57 242 05 13	3379.0 3328.7	3089.6 3043.9	1.92 1.89
M. Lloyd.....	38 52 39.61	76 09 15.10	41 54 32 16 18 34	Mouth of Wye River..... E. Lloyd.....	221 53 04 196 18 16	5523.2 2660.5	5050.6 2432.8	3.14 1.51
White House, (1)	38 52 13.14	76 08 00.38	58 34 31 114 23 32	E. Lloyd..... M. Lloyd.....	238 33 26 294 22 45	3184.3 2162.4	2911.8 1977.4	1.81 1.21
White House, (2)	38 52 42.83	76 08 23.15	85 28 31 329 04 00	M. Lloyd..... White House, (1)	265 27 58 149 04 14	1373.7 1167.4	1256.2 1067.5	0.78 0.66
White House, (3)	38 52 27.55	76 07 33.90	55 09 24 111 39 34	White House, (1)	235 09 08	850.6	777.8	0.48
				White House, (2)	291 39 04	1396.6	1277.1	0.79

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Paca	38 52 59.18	76 06 47.34	77 43 53 49 03 15	White House, (2)	257 42 53	2363.0	2584.1	1.47
				White House, (3)	229 02 45	1485.7	1624.7	0.92
Daniel Lloyd, (1)	38 52 26.00	76 06 44.01	92 21 43 175 30 43	White House, (3)	272 21 11	1203.5	1316.1	0.75
				Paca	355 30 41	1026.4	1122.4	0.64
Daniel Lloyd, (2)	38 52 37.65	76 06 24.78	140 40 54 52 12 51	Paca	320 40 40	858.2	938.5	0.53
				Daniel Lloyd, (1)	232 12 39	586.5	641.4	0.37
Daniel Lloyd, (3)	38 52 39.37	76 05 59.35	117 50 47 69 02 42	Paca	297 50 17	1308.2	1430.6	0.81
				Daniel Lloyd, (1)	249 02 14	1152.8	1260.7	0.72
Wye Landing	38 53 08.16	76 05 41.36	26 01 39 48 03 29	Daniel Lloyd, (3)	206 01 48	987.7	1080.1	0.61
				Daniel Lloyd, (2)	228 03 02	1406.9	1538.5	0.87
St. Michael's River.								
Fairview	38 48 08.12	76 11 43.53	146 47 46 182 33 29	Tilghman's Point	326 45 48	8240.2	9011.2	5.12
				Mouth of Wye	2 33 34	4615.9	5047.8	2.87
Deep Water Point	38 48 21.65	76 12 29.42	197 22 41 290 38 15	Mouth of Wye	17 23 15	4394.9	4806.1	2.73
				Fairview	110 38 44	1183.2	1294.0	0.73
Herring Island	38 50 02.67	76 12 40.62	235 41 57 338 42 00	Mouth of Wye	55 42 38	1915.6	2094.9	1.19
				Fairview	158 42 36	3790.9	4145.6	2.36
Little Neck Point	38 46 30.61	76 11 36.73	176 52 56 159 38 02	Fairview	356 52 52	3011.0	3292.7	1.87
				Deep Water Point	339 37 29	3652.1	3993.8	2.27
Loockerman	38 45 23.52	76 09 42.54	143 45 56 126 54 08	Deep Water Point	323 44 11	6810.8	7447.9	4.23
				Little Neck Point	306 52 56	3446.5	3769.0	2.14

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Long Point, (2).....	38 46 08.63	76 10 05.04	107 02 28 338 40 09	Little Neck Point.....	287 01 31	2314.7	2531.3	1.44
Sandy Point.....	38 46 42.59	76 08 45.57	29 26 04 61 22 51	Loockerman.....	158 40 24	1493.2	1632.9	0.93
Perry Hall.....	38 46 14.11	76 08 58.58	83 59 56 199 40 29	Long Point, (2).....	209 25 28 241 22 01	2799.2 2185.4	3061.1 2389.9	1.74 1.36
Bartlett.....	38 46 59.40	76 08 06.17	61 25 10 42 10 48	Long Point, (2).....	263 59 14 19 40 37	1613.2 932.6	1764.2 1019.9	1.00 0.58
Lowndes.....	38 47 30.11	76 08 03.38	34 48 08 4 04 03	Sandy Point.....	241 24 45 222 10 15	1083.0 1884.2	1184.3 2060.5	0.67 1.17
Goldsborough.....	38 47 43.94	76 06 50.71	55 42 03 76 20 26	Perry Hall.....	214 47 41 184 04 01	1784.2 949.4	1951.2 1038.2	1.11 0.59
Chesapeake Bay, Choptank River.				Sandy Point.....	235 40 51 256 19 40	3355.7 1804.6	3669.7 1973.5	2.09 1.12
BLAKE.....	38 39 41.88	76 31 55.79		Lowndes.....				
HILL'S POINT.....	38 34 04.14	76 18 37.26						
WILSON.....	38 26 18.29	76 26 39.38						
Tilghman's Island.....	38 39 59.45	76 20 23.62	346 46 28 88 12 20	Hill's Point.....	166 47 35 268 05 07	11253.1 16741.1	12306.1 18307.6	6.99 10.40
Sharpe's Island, (1).....	38 37 27.02	76 21 25.80	20 14 53 326 53 01	Blake.....				
				Wilson.....	200 11 38 146 54 46	21972.8 7466.7	24028.6 8165.4	13.65 4.64

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Cooke's Point.....	38 37 59.53	76 17 21.04	80 24 28 14 15 50	Sharpe's Island, (1)..... Hill's Point.....	260 21 55 194 15 03	6003.7	6565.5	3.73
						7488.2	8188.9	4.65
Nelson's Point.....	38 41 51.61	76 15 41.52	63 07 54 18 35 32	Tilghman's Island..... Cooke's Point.....	243 04 58 198 34 30	7644.9	8360.2	4.75
						7549.1	8255.5	4.69
Harris Creek.....	38 43 00.43	76 19 12.83	343 45 11 292 33 06	Cooke's Point..... Nelson's Point.....	163 46 21 112 35 18	9662.8	10567.0	6.01
						5528.5	6045.8	3.44
Royston's Island.....	38 41 31.09	76 13 39.13	39 27 17 102 05 04	Cooke's Point..... Nelson's Point.....	219 24 58 282 03 47	8445.6	9235.9	5.23
						3024.4	3307.5	1.88
Skinner.....	38 43 55.69	76 15 13.40	10 04 11 332 55 59	Nelson's Point..... Royston's Island.....	190 03 53 152 56 58	3885.7	4249.3	2.42
						5006.5	5475.0	3.11
Hambleton's Island.....	38 44 52.82	76 13 33.90	28 53 48 53 45 48	Nelson's Point..... Skinner.....	208 52 28 233 44 46	6381.4	6978.5	3.97
						2979.4	3258.2	1.85
Todd's Point.....	38 37 53.34	76 13 53.82	92 12 03 160 29 48	Cooke's Point..... Nelson's Point.....	272 09 53 340 28 40	5015.1	5484.4	3.11
						7794.1	8523.4	4.81
Benoni's Point.....	38 40 10.36	76 11 44.28	118 35 19 36 33 44	Nelson's Point..... Todd's Point.....	298 32 50 216 32 23	6528.0	7138.8	4.06
						5259.1	5751.2	3.27
Castle Haven.....	38 37 43.44	76 09 57.28	93 04 26 150 16 42	Todd's Point..... Benoni's Point.....	273 01 59 330 15 36	5728.7	6264.8	3.56
						5216.7	5704.8	3.24
Bachelor's Point.....	38 40 13.22	76 10 08.14	87 50 04 356 44 40	Benoni's Point..... Castle Haven.....	267 49 04 176 44 46	2325.5	2543.1	1.45
						4625.6	5058.4	2.87
Glory Point.....	38 38 11.03	76 08 36.37	129 01 05 66 30 24	Benoni's Point..... Castle Haven.....	308 59 08 246 29 33	5846.0	6393.0	3.63
						2133.7	2333.4	1.33

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

354

S. Doc. 3.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.		Distance.	Distance.	Distance.
					° ' "	Yards.		Miles.	
Howell's Point.....	38 36 43.06	76 06 27.08	129 49 59 110 07 49	Benoni's Point..... Castle Haven.....	309 46 41 290 05 37	10918.4 5920.9	6.20 3.37		
Horn Point.....	38 36 18.49	76 08 07.68	134 39 51 252 42 16	Castle Haven..... Howell's Point.....	314 38 42 72 43 19	4075.3 2787.4	2.32 1.59		
Hambrook's Point.....	38 35 31.30	76 05 00.27	136 30 10 107 48 43	Howell's Point..... Horn Point.....	316 29 16 287 46 46	3336.4 5207.9	1.90 2.96		
Porpoise Creek	38 36 15.58	76 03 04.10	99 48 51 64 06 32	Howell's Point..... Hambrook's Point.....	279 46 45 244 05 20	5449.7 3417.3	3.10 1.94		
Tate's Bank.....	38 33 39.50	76 02 24.66	132 28 58 168 47 21	Hambrook's Point..... Porpoise Creek	312 27 21 348 46 56	5583.1 5364.7	3.17 3.05		
Chancellor's Point.....	38 34 41.48	76 01 20.31	106 07 10 39 11 36	Hambrook's Point..... Tate's Bank.....	286 04 53 219 10 56	6058.5 2695.9	3.44 1.53		
Sand Hill.....	38 35 06.27	76 05 58.48	166 57 09 125 28 41	Howell's Point..... Horn Point.....	346 56 51 305 27 20	3350.2 4197.3	1.91 2.38		
Reid.....	38 36 49.55	76 04 37.78	85 41 15 12 43 01	Howell's Point..... Hambrook's Point.....	265 40 07 192 42 47	2899.8 2704.6	1.65 1.54		
Oystershell Point.....	38 34 45.53	75 59 26.41	64 45 34 87 25 05	Tate's Bank..... Chancellor's Point.....	244 43 43 267 23 54	5217.2 3017.8	2.97 1.72		
Waggaman.....	38 34 13.96	76 00 09.42	72 02 24 116 19 34	Tate's Bank..... Chancellor's Point.....	252 01 00 296 18 50	3763.7 2093.4	2.14 1.19		
Goose Point.....	38 35 40.20	75 59 43.98	52 10 49 13 02 28	Chancellor's Point..... Waggaman	232 09 49 193 02 12	3227.8 2984.7	1.83 1.70		

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Stewart.....	38 35 41.93	75 58 21.36	42 09 49 88 28 43	Oystershell Point.....	222 09 08	2345.6	2565.1	1.46
				Goose Point.....	268 27 51	1999.9	2187.0	1.24
Warwick.....	38 36 53.77	75 58 09.42	45 15 19 7 26 07	Goose Point.....	225 14 20	3221.8	3523.3	2.00
				Stewart.....	187 26 00	2233.7	2442.7	1.39
Jamaica Point.....	38 36 36.29	75 58 53.34	243 05 34 35 19 38	Warwick.....	63 06 01	1191.3	1302.8	0.74
				Goose Point.....	215 19 06	2119.5	2317.9	1.32
Case.....	38 37 35.09	75 59 16.21	339 10 38 308 15 21	Stewart.....	159 11 13	2732.6	2988.3	1.70
				Warwick.....	128 16 03	2057.2	2249.7	1.28
Small.....	38 38 20.35	75 58 19.72	354 40 25 44 24 02	Warwick.....	174 40 31	2680.9	2931.8	1.67
				Case.....	224 23 26	1952.9	2135.6	1.21
Cabin Creek.....	38 37 48.97	75 57 38.88	79 42 35 134 25 24	Case.....	259 41 34	2392.4	2616.3	1.49
				Small.....	314 24 59	1382.6	1512.7	0.86
Jacob.....	38 38 55.37	75 56 44.48	64 53 31 32 44 02	Small.....	244 52 32	2543.6	2781.6	1.58
				Cabin Creek.....	212 43 28	2433.7	2661.4	1.51
Hunting Creek.....	38 40 11.35	75 56 26.48	38 40 22 10 31 39	Small.....	218 39 12	4382.7	4792.9	2.72
				Jacob.....	190 31 28	2382.6	2605.6	1.48
Barnes.....	38 39 59.97	75 57 10.89	342 13 43 251 54 51	Jacob.....	162 13 59	2091.8	2287.5	1.30
				Hunting Creek.....	71 55 18	1129.3	1235.0	0.70
Goldsborough.....	38 41 02.64	75 57 05.16	329 24 51 4 06 12	Hunting Creek.....	149 25 15	1837.3	2009.2	1.14
				Barnes.....	184 06 09	1937.2	2118.5	1.20
Ross.....	38 41 05.07	75 58 16.08	302 00 48 272 29 45	Hunting Creek.....	122 01 56	3124.1	3416.5	1.94
				Goldsborough.....	92 30 29	1715.5	1876.0	1.06

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Frazer.....	38 42 13.27	75 58 58.07	308 35 27 334 14 34	Goldsborough..... Ross.....	128 36 37 154 15 00	2490.8 2334.9	2723.8 2553.4	1.55 1.45
Lloyd.....	38 42 02.67	75 59 38.05	311 52 28 251 17 57	Ross..... Frazer.....	131 53 19 71 18 22	2660.4 1019.9	2909.3 1115.3	1.65 0.63
Malone.....	38 43 04.58	76 00 28.66	305 51 27 327 21 43	Frazer..... Lloyd.....	125 52 24 147 22 15	2700.4 2266.9	2953.1 2479.0	1.68 1.41
Hog Island.....	38 43 53.60	75 59 47.86	356 02 36 33 06 52	Lloyd..... Malone.....	176 02 43 213 06 27	3428.7 1804.5	3749.5 1973.4	2.13 1.12
Stevens.....	38 44 26.75	76 00 13.11	8 26 14 329 10 21	Malone..... Hog Island.....	188 26 04 149 10 36	2561.2 1190.2	2800.9 1301.6	1.59 0.74
Cook.....	38 44 51.03	75 59 13.19	25 19 00 62 39 35	Hog Island..... Stevens.....	205 18 38 242 38 58	1958.5 1629.2	2141.8 1781.6	1.22 1.01
Dover.....	38 45 30.42	75 59 28.03	29 00 59 343 33 33	Stevens..... Cook.....	209 00 31 163 33 42	2244.6 1266.3	2454.6 1384.8	1.40 0.79
Willis.....	38 45 28.83	75 58 46.54	28 54 15 92 48 19	Cook..... Dover.....	208 53 58 272 47 53	1331.4 1003.0	1456.0 1096.6	0.83 0.62
Kingstown.....	38 46 45.09	75 57 56.13	43 56 54 27 22 13	Dover..... Willis.....	223 55 57 207 21 42	3197.3 2647.5	3496.5 2895.2	1.99 1.65
Providence.....	38 46 13.04	75 57 46.66	61 46 22 166 59 04	Dover..... Kingstown.....	241 45 19 346 58 58	2777.7 1014.1	3037.6 1109.0	1.74 0.63
Sullivan.....	38 46 51.76	75 56 14.97	85 11 40 61 39 59	Kingstown..... Providence.....	265 10 36 241 39 01	2450.0 2514.5	2679.2 2749.8	1.52 1.56

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Clark	38 46 57.80	75 57 09.24	33 12 54 278 04 51	Providence	213 12 31	1649.1	1803.4	1.03
Wing's Landing	38 47 14.49	75 55 40.28	50 05 00 76 31 53	Sullivan	98 05 25	1322.8	1446.6	0.83
High Bank	38 47 29.57	75 55 53.09	24 23 03 326 24 28	Sullivan	230 04 38	1091.7	1193.9	0.68
				Clark	256 30 57	2207.6	2414.2	1.37
				Sullivan	204 22 49	1279.7	1399.4	0.80
				Wing's Landing	146 24 36	558.3	610.6	0.35
<i>Third Haven Creek.</i>								
Oxford	38 41 22.08	76 10 12.98	44 56 59 356 51 06	Benoni's Point	224 56 02	3123.9	3416.3	1.94
Battee	38 41 36.36	76 10 48.47	339 11 06 297 10 33	Bachelor's Point	176 51 09	2126.2	2325.2	1.32
Tilghman	38 41 52.79	76 09 21.20	52 53 14 76 29 49	Bachelor's Point	159 11 28	2742.2	2998.8	1.70
Morling	38 42 17.68	76 09 24.50	57 52 47 354 04 19	Oxford	117 10 55	963.9	1054.1	0.60
Eagle Point	38 42 27.09	76 07 48.20	64 48 30 82 54 16	Battee	232 52 42	1569.2	1716.0	0.98
Mare's Neck	38 42 35.80	76 08 44.85	33 31 38 281 05 57	Battee	256 28 55	2168.7	2371.6	1.35
Hambleton	38 43 05.99	76 08 08.17	338 05 32 43 35 37	Tilghman	237 51 55	2395.7	2619.9	1.49
				Eagle Point	174 04 21	7715.4	8437.3	4.79
				Morling	244 47 32	2483.4	2715.8	1.55
				Tilghman	262 53 16	2344.6	2564.0	1.46
				Eagle Point	213 31 15	1590.5	1739.3	0.99
				Mare's Neck	101 06 32	1394.6	1525.1	0.87
				Hambleton	158 05 44	1292.7	1413.7	0.81
					223 35 14	1285.1	1405.4	0.80

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Diamond Hall	38 43 33.01	76 08 25.75	14 39 37 232 59 28	Mare's Neck..... Hambleton	194 39 25 152 59 39	1823.3 935.1	1993.9 1022.6	1.13 0.58
Long Point.....	38 44 03.99	76 07 54.22	10 40 51 33 34 57	Hambleton	190 40 46	1819.6	1989.9	1.13
Dr. Clough	38 43 45.86	76 07 56.11	61 03 26 184 41 03	Diamond Hall..... Long Point.....	218 34 38 241 03 08 4 41 09	1221.6 818.2 560.8	1335.9 894.8 613.2	0.76 0.51 0.35
Haywood.....	38 43 59.85	76 07 03.46	95 56 52 71 16 01	Long Point..... Dr. Clough.....	275 56 20 251 15 28	1232.4 1342.8	1347.7 1468.5	0.77 0.83
Cedar Point.....	38 44 34.11	76 06 42.21	61 53 57 25 54 46	Long Point..... Haywood.....	241 53 11 205 54 32	1971.4 1174.4	2155.9 1284.3	1.23 0.73
Neck Point.....	38 44 35.84	76 07 05.76	357 08 18 275 20 36	Haywood..... Cedar Point	177 08 19 95 20 51	1110.9 571.1	1214.9 624.5	0.69 0.36
Bartlett.....	38 45 16.95	76 06 49.37	352 32 36 17 20 14	Cedar Point	172 32 41	1332.1	1456.8	0.83
Watermelon Point	38 45 01.85	76 06 43.23	162 20 24	Neck Point.....	197 20 04	1328.0	1452.3	0.82
Holliday	38 45 43.25	76 06 07.87	34 09 23 51 01 18 33 46 31	Neck Point..... Bartlett..... Bartlett	214 09 09 342 20 20	969.0 488.8	1059.7 534.6	0.60 0.31
Hudson River, (Little Chop- tank.)				Watermelon Point.....	231 00 52 213 46 09	1289.0 1535.8	1409.7 1679.5	0.80 0.96
James' Point	38 31 54.36	76 19 49.71	203 39 51 167 14 02	Hill's Point..... Sharpe's Island, (1).....	23 40 36 347 13 02	4369.1 10516.8	4777.9 11500.9	1.77 6.53

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay.—Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Hooper's Point	38 30 19.53	76 16 51.60	159 43 59 124 08 34	Hill's Point	339 42 53	7382.8	8073.7	4.59
				James' Point	304 06 43	5211.4	5699.0	3.24
Ragged Point.....	38 31 44.04	76 16 12.28	93 28 34 20 05 08	James' Point.....	273 26 19	5275.3	5768.9	3.28
				Hooper's Point.....	200 04 43	2774.3	3033.9	1.73
Susquehanna Point.....	38 31 19.36	76 14 36.98	60 30 53 108 15 09	Hooper's Point	240 29 29	3746.7	4097.3	2.33
				Ragged Point	288 14 10	2430.2	2657.6	1.51
McKeel's Point	38 32 16.90	76 13 08.49	77 11 49 50 23 59	Ragged Point.....	257 09 55	4564.9	4992.0	2.84
				Susquehanna Point	230 23 04	2782.0	3042.3	1.73
Hudson's Creek.....	38 32 37.74	76 14 10.76	14 43 44 293 04 34	Susquehanna Point	194 43 28	2498.4	2732.2	1.55
				McKeel's Point	113 05 13	1639.2	1792.6	1.02
Cedar Point.....	38 33 00.88	76 12 59.87	8 45 08 67 26 23	McKeel's Point	188 45 02	1372.0	1501.0	0.85
				Hudson's Creek.....	247 25 38	1858.9	2032.8	1.16
Skinner	38 33 08.35	76 12 00.34	46 08 21 80 55 47	McKeel's Point	226 07 38	2289.0	2503.2	1.42
				Cedar Point	260 55 10	1459.7	1596.3	0.91
Solomon's Cove.....	38 33 36.37	76 11 27.99	63 49 15 42 12 13	Cedar Point	243 48 18	2479.1	2711.1	1.54
				Skinner	222 11 53	1166.0	1274.9	0.72
Patterson	38 33 33.99	76 10 11.21	73 21 31 92 16 27	Skinner	253 20 23	2757.7	3015.8	1.71
				Solomon's Cove.....	272 15 39	1860.1	2034.2	1.15
Chesapeake Bay								
Plum Point.....	38 37 29.08	76 30 40.81	252 41 22 175 39 05	Tilghman's Island	72 47 47	15627.0	17089.2	9.71
				Holland's Point	355 38 45	10029.4	10967.8	6.23

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Chew	38 40 20.29	76 31 32.28	272 13 08 346 43 49	Tilghman's Island	92 20 06	16175.4	17688.9	10.05
				Plum Point	166 44 22	5423.2	5930.6	3.37
Sharpe's Island, (2)	38 36 39.17	76 22 07.84	339 08 46 18 59 04	James' Point	159 10 12	2848.2	3114.7	1.77
				Wilson	198 56 15	20241.3	22135.3	12.58
Sharpe's Island Light	38 37 43.75	76 21 55.23	104 07 55 174 22 45	Blake	284 01 40	14971.2	16372.1	9.30
				Poplar Island, (1)	354 22 09	14310.8	15649.9	8.89
Parran	38 32 50.28	76 30 43.45	262 33 20 333 54 17	Hill's Point	82 40 53	17727.3	19386.0	11.01
				Wilson	153 56 49	13455.0	14714.0	8.36
Dr. Dorsey	38 30 06.42	76 30 01.55	246 04 52 325 06 59	Hill's Point	66 11 53	18120.1	19815.6	11.26
				Wilson	145 09 05	8572.4	9374.5	5.33
James' Island	38 31 54.71	76 20 46.69	174 43 44 218 08 03	Sharpe's Island, (1)	354 43 19	10289.1	11251.9	6.39
				Hill's Point	38 09 24	50742.8	55490.8	31.53
S. Y. Dorsey	38 32 50.29	76 30 43.42	276 42 45 348 38 40	James' Island	96 48 57	14550.9	15912.4	9.04
				Dr. Dorsey	168 39 06	5153.2	5635.4	3.20
Bond	38 29 02.70	76 30 16.20	241 10 17 313 56 35	Hill's Point	61 17 32	19311.8	21118.8	12.00
				Wilson	133 58 50	7302.2	7985.5	4.54
Wilson, (2)	38 26 31.32	76 26 51.02	254 14 12 221 29 43	Taylor's Island	74 18 39	10833.1	11846.8	6.73
				James' Island	41 33 20	13318.0	14564.2	8.27
Taylor's Island	38 24 06.56	76 19 40.90	334 33 36 24 44 23	Meekin's Neck	154 35 27	10101.3	11046.5	6.28
				Cove Point	204 42 34	10159.6	11110.1	6.31
TRAVERS	38 28 06.84	76 19 30.85	.....	.....	.....	.....	.....	.....

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

S. Doc. 3.

361

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
MEEKIN'S NECK.....	38 23 10.66	76 16 42.09	0 ' "	.....	0 ' "	.....	.....	.....
CALVERT.....	38 21 30.68	76 23 16.16	.....	.....	.....	.....	.....	.....
CEDAR POINT.....	38 17 54.09	76 21 42.77	.....	.....	.....	.....	.....	.....
Cove Point.....	38 23 07.24	76 22 36.10	204 42 20	Taylor's Island.....	24 44 09	10159.6	11110.3	6.31
			140 09 09	Dr. Dorsey.....	320 04 32	16843.1	18419.2	10.47
*Cove Point Light.....	38 23 06.60	76 22 36.40	18 05 00	Calvert.....	198 05 00	3104.0	3394.4	1.93
Barren Island.....	38 19 37.25	76 15 45.65	69 53 51	Cedar Point.....	249 50 09	9239.3	10103.8	5.74
			168 14 33	Meekin's Neck.....	348 13 58	6721.1	7350.0	4.18
Ponds.....	38 18 19.01	76 13 08.23	86 31 37	Cedar Point.....	266 26 18	12524.1	13696.0	7.78
			111 52 01	Calvert.....	291 45 44	15901.9	17389.8	9.88
<i>Patuxent river.</i>								
Hog Island.....	38 18 33.60	76 23 39.34	260 16 46	Barren Island.....	80 21 39	11671.5	12764.1	7.25
			293 15 36	Cedar Point.....	113 16 48	3082.5	3370.9	1.92
Slatt.....	38 19 41.95	76 24 46.47	270 35 13	Barren Island.....	90 40 48	13135.1	14364.2	8.16
			322 16 12	Hog Island.....	142 16 54	2663.7	2912.9	1.66
Carroll.....	38 18 13.82	76 24 43.70	248 40 41	Hog Island.....	68 41 21	1678.0	1835.0	1.04
			178 35 20	Slatt.....	358 35 18	2717.9	2972.2	1.69
Jones, (2).....	38 19 33.15	76 25 15.20	248 45 32	Slatt.....	68 45 50	748.8	818.9	0.47
			342 37 44	Carroll.....	162 38 04	2562.6	2802.4	1.60

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Sandy Point.....	38 18 53.15	76 27 01.82	244 31 24 289 51 21	Jones, (2)..... Carroll	64 32 27 109 52 46	2868.3 3567.4	3136.7 3899.2	1.78 2.22
Woodyard.....	38 17 30.42	76 26 50.94	174 05 02 246 34 49	Sandy Point..... Carroll	354 04 55 66 36 08	2564.3 3368.5	2804.2 3683.7	1.60 2.09
Thomas.....	38 18 26.22	76 27 54.47	237 00 41 318 05 43	Sandy Point..... Woodyard	57 01 13 138 06 22	1524.9 2311.5	1667.6 2527.8	0.95 1.44
Town Point, (2)	38 19 12.18	76 28 21.97	286 45 43 324 48 40	Sandy Point..... Woodyard	106 46 33 144 49 37	2033.4 3838.4	2223.7 4197.6	1.26 2.39
Somerville.....	38 19 49.52	76 27 49.41	326 22 07 34 29 35	Sandy Point..... Town Point, (2).....	146 22 37 214 29 15	2087.1 1396.7	2282.4 1527.4	1.30 0.87
Abell	38 19 50.60	76 29 15.54	270 54 18 212 18 38	Somerville	90 55 11 132 19 11	2092.1 1759.5	2287.9 1923.9	1.30 1.09
Hungerford	38 21 09.02	76 28 21.72	342 14 49 28 23 42	Somerville	162 15 09 208 23 09	2573.8 2748.5	2814.6 3005.7	1.60 1.71
Gilliam	38 21 20.92	76 29 56.92	279 00 45 312 17 55	Hungerford	99 01 44 132 19 14	2340.0 4186.6	2559.0 4578.3	1.45 2.60
Petersen	38 23 28.71	76 30 05.76	329 36 28 356 52 56	Hungerford	149 37 32 176 53 01	4992.7 3945.7	5459.9 4314.9	3.10 2.45
Setterly Point.....	38 22 48.47	76 31 42.62	302 08 36 242 09 54	Hungerford	122 10 40 62 10 54	5760.4 2657.9	6299.4 2907.1	3.58 1.65
St. Leonard's Creek.....	38 23 06.03	76 29 36.47	8 42 38 134 32 18	Gilliam	188 42 25 314 32 00	3278.3 997.1	3585.1 1090.4	2.04 0.62

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Brougham's Island.....	38 24 37.26	76 32 29.42	301 13 11 341 17 40	Petersen..... Setterly Point.....	121 14 40 161 18 09	4076.1 3541.2	4457.5 3872.6	2.53 2.20
High Bank.....	38 23 16.65	76 32 58.61	195 54 09 264 55 06	Brougham's Island..... Petersen.....	15 54 27 84 56 53	2584.3 4210.7	2826.1 4604.7	1.61 2.62
Barnes.....	38 25 25.41	76 34 12.61	300 39 35 300 58 33	Brougham's Island..... Petersen.....	120 40 39 121 01 07	2910.0 6986.2	3182.3 7636.9	1.81 4.34
Reeder.....	38 25 53.79	76 37 45.61	279 35 39 304 48 24	Barnes..... High Bank.....	99 37 52 124 51 23	5239.5 8482.0	5729.8 9275.7	3.26 5.27
Maud's Hill.....	38 24 38.93	76 36 03.67	241 58 55 133 02 08	Barnes..... Reeder.....	62 00 04 313 01 05	3051.5 3382.4	3337.0 3698.9	1.90 2.10
Ayres.....	38 26 01.87	76 35 14.65	24 56 28 86 07 12	Maud's Hill..... Reeder.....	204 55 58 266 05 38	2820.1 3669.7	3084.0 4013.7	1.75 2.28
McDaniell.....	38 28 08.41	76 39 23.38	330 15 41 302 52 50	Reeder..... Ayres.....	150 16 42 122 55 25	4780.0 7182.4	5227.3 7854.5	2.97 4.46
Duke.....	38 28 15.83	76 37 47.10	318 09 53 84 24 24	Ayres..... McDaniell.....	138 11 28 264 23 24	5542.5 2344.9	6061.1 2564.3	3.44 1.46
Holland Point.....	38 30 09.93	76 39 30.61	357 19 10 324 30 03	McDaniell..... Duke.....	177 19 14 144 31 08	3750.8 4320.7	4101.8 4725.0	2.33 2.68
Shirley Point.....	38 28 01.22	76 38 22.64	98 33 59 240 23 22	McDaniell..... Duke.....	278 33 21 62 23 44	1483.9 972.1	1628.2 1063.1	0.93 0.60
Washington.....	38 30 45.19	76 41 16.10	330 23 36 330 31 04	Reeder..... McDaniell.....	150 25 47 150 32 17	10332.0 5551.9	11298.8 6071.4	6.42 3.45

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
<i>Honga River.</i>								
Tom's Point.....	38 15 37.94	76 10 54.48						
Ben's Point.....	38 18 46.41	76 13 03.57	331 37 29 82 45 27	Tom's Point..... Cedar Point.....	151 38 49 262 40 05	6603.3 12715.9	7221.2 13905.7	4.10 7.90
Johnson.....	38 18 37.00	76 07 58.45	92 16 02 37 47 17	Ben's Point..... Tom's Point.....	272 12 53 217 45 28	7418.1 6984.1	8112.2 7637.6	4.61 4.34
Smoke Point.....	38 17 37.01	76 11 16.61	248 58 07 129 28 37	Johnson..... Ben's Point.....	69 00 10 309 27 31	5157.8 3366.1	5640.4 3681.1	3.21 2.09
Crabb Point.....	38 15 13.68	76 05 51.03	119 12 39 153 43 52	Smoke Point..... Johnson.....	299 09 17 233 42 33	9062.7 6991.2	9910.7 7645.4	5.63 4.34
Hickory Point.....	38 16 05.55	76 10 10.36	284 12 43 214 27 48	Crabb Point..... Johnson.....	104 15 23 34 29 10	6503.4 5664.2	7111.9 6194.2	4.04 3.52
Long Ridge.....	38 13 52.58	76 08 16.05	145 52 56 234 38 58	Hickory Point..... Crabb Point.....	325 51 45 54 40 28	4952.4 4323.1	5415.8 4727.6	3.08 2.69
Windmill.....	38 16 28.61	76 08 38.41	72 21 17 299 34 33	Hickory Point..... Crabb Point.....	252 20 20 119 36 16	2345.3 4678.5	2564.8 5116.3	1.46 2.91
Hickory Cove.....	38 15 22.85	76 09 54.43	222 20 32 272 42 51	Windmill..... Crabb Point.....	42 21 19 92 45 22	2743.3 5923.8	3000.0 6478.1	1.71 3.68
Old Town Point.....	38 18 56.59	76 09 46.41	86 16 06 340 05 38	Ben's Point..... Windmill.....	266 14 04 160 06 20	4799.5 4851.8	5248.6 5305.8	2.98 3.01

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

S. Doc. 3.

365

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Wheatley.....	38 19 53.83	76 11 06.18	3 26 54 330 25 24	Smoke Point Windmill ..	183 26 48 150 26 56	4226.1 7274.0	4621.5 7954.6	2.63 4.52
Bar Neck	38 21 39.40	76 11 22.66	24 41 28 352 59 24	Ben's Point..... Wheatley.....	204 40 25 172 59 34	5869.6 3279.1	6418.8 3585.9	3.65 2.04
Fishing Creek.....	38 20 47.23	76 13 12.07	238 47 56 298 17 43	Bar Neck Wheatley.....	58 49 03 118 19 01	3105.2 3472.2	3395.8 3797.1	1.93 2.16
Hooper's Straits, Fishing Bay.								
HOLLAND.....	38 06 36.29	76 05 14.88						
Bishop's Head.....	38 13 22.73	76 02 40.82	109 11 35 16 40 25	Tom's Point..... Holland	289 06 30 196 38 50	12706.2 13079.6	13895.1 14303.5	7.90 8.13
Turkey Point.....	38 09 54.02	75 56 41.51	64 02 51 126 23 10	Holland Bishop's Head	243 57 34 306 19 28	13907.3 10854.9	15218.7 11870.6	8.64 6.74
Bloodsworth.....	38 10 32.82	76 05 18.43	79 11 09 359 19 21	Point No Point Holland.....	259 02 39 179 19 23	20467.3 7292.5	22382.4 7974.9	12.72 4.35
Thomas.....	38 06 48.15	75 56 33.57	143 43 26 88 23 42	Bishop's Head Holland.....	323 39 39 268 18 20	15095.6 12703.3	16508.1 13892.5	9.38 7.89
Frank's Island.....	38 11 26.96	75 54 59.60	107 41 15 14 54 45	Bishop's Head Thomas.....	287 36 30 194 53 47	11773.9 8894.6	12875.6 9726.9	7.31 5.53
Piny Hammock.....	38 11 42.25	76 02 03.13	318 28 07 272 35 01	Thomas..... Frank's Island.....	138 31 30 92 39 22	12106.6 10315.6	13239.4 11280.8	7.52 6.41

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.		
					° ' "	Metres.	Yards.	Miles.	Distance.	Distance.
Sandy Island	38 14 38.49	75 56 04.71	58 05 47 344 58 56	Piny Hammock	238 02 05	10272.2	11233.4	6.38		
				Frank's Island	164 59 36	6113.7	6635.8	3.80		
Roseneer	38 17 01.32	76 01 37.73	3 35 40 298 30 58	Piny Hammock	183 35 24	9856.5	10778.8	6.12		
				Sandy Island	118 34 24	9215.1	10077.4	5.73		
Fishing Point	38 18 20.71	76 00 39.56	327 01 52 315 42 08	Frank's Island	147 05 22	15199.8	16622.1	9.44		
				Sandy Island	135 44 58	9568.6	10463.9	5.95		
Ragged Point	38 17 28.22	75 54 03.16	29 27 37 85 44 40	Sandy Island	209 26 21	6009.4	6571.7	3.73		
				Roseneer	265 39 58	11077.2	12113.7	6.88		
Wilson's Island	38 18 48.31	75 59 02.21	330 44 01 288 44 41	Sandy Island	150 45 51	8827.7	9653.9	5.49		
				Ragged Point	108 47 46	7673.5	8391.5	4.77		
Green's Island	38 20 31.66	75 54 23.29	355 03 25 64 49 54	Ragged Point	175 03 37	5676.7	6207.9	3.53		
				Wilson's Island	244 47 01	7486.3	8168.8	4.65		
Roaring Point	38 15 52.63	75 54 39.88	42 04 06 196 50 43	Sandy Island	222 03 14	3078.4	3366.5	1.91		
				Ragged Point	16 51 06	3079.3	3367.4	1.91		
Mulberry Island	38 16 21.71	75 55 58.95	233 54 28 2 31 17	Ragged Point	53 55 40	3481.7	3807.5	2.16		
				Sandy Island	182 31 13	3185.3	3483.4	1.98		
Snake Island	38 21 11.88	76 00 18.59	307 03 57 5 30 55	Ragged Point	127 07 50	11432.3	12502.0	7.10		
				Fishing Point	185 39 42	5301.7	5797.8	3.29		
Jones' Island	38 18 12.25	76 02 46.70	265 09 47 322 32 20	Fishing Point	85 11 06	3099.6	3339.6	1.93		
				Roseneer	142 53 01	2755.0	3013.0	1.71		
Gray's Island	38 20 26.69	75 57 26.39	61 58 53 108 26 47	Jones' Island	241 55 34	8814.8	9639.6	5.48		
				Snake Island	288 25 00	4407.0	4819.4	2.47		

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Yards.	Metres.	Miles.
Insley's Mill	38 18 56.04	76 02 50.68	288 51 51 355 53 36	Fishing Point.....	108 53 12	3681.3	3366.3	2.09
				Jones' Island	175 53 39	1479.9	1353.3	0.84
Clay Island Light	38 13 53.05	75 58 08.46	245 01 27 54 46 44	Sandy Island	65 02 44	3629.9	3319.3	2.06
				Piny Hammock	234 44 19	7643.0	6989.0	4.34
Ballard	38 14 20.21	75 50 40.72	49 42 59 94 07 11	Frank's Island.....	229 40 18	9030.0	8257.4	5.13
				Sandy Island	274 03 51	8637.0	7898.0	4.91
Long Point, (Monie Bay)	38 12 10.02	75 53 02.94	136 00 45 220 44 39	Sandy Island	315 58 53	6958.9	6363.5	3.95
				Ballard	40 46 07	5794.5	5298.7	3.30
Stump Point.....	38 13 38.86	75 53 32.26	252 59 27 87 54 50	Ballard	73 01 13	4769.8	4361.7	2.71
				Bishop's Head	267 49 11	14599.5	13350.3	8.29
<i>Nanticoke River.</i>								
Cow Creek.....	38 18 36.66	75 55 42.30	208 25 12 311 12 39	Green's Island.....	28 26 01	4408.6	4031.4	2.50
				Ragged Point.....	131 13 40	3502.1	3202.4	1.99
Hat Crown Point.....	38 19 32.81	75 52 45.11	68 06 37 127 17 08	Cow Creek.....	248 04 47	5073.0	4638.9	2.88
				Green's Island	307 16 07	3276.6	2996.2	1.86
Beach	38 21 02.06	75 52 57.67	353 40 43 65 44 49	Hat Crown Point.....	173 40 51	3027.6	2768.5	1.72
				Green's Island	245 43 56	2493.8	2280.4	1.42
Cedar Hammock.....	38 20 41.51	75 51 33.78	39 17 08 107 17 17	Hat Crown Point.....	219 16 23	2992.3	2736.3	1.70
				Beach	287 16 25	2332.7	2133.1	1.33
Brick Kiln Cove.....	38 22 20.29	75 51 51.09	352 08 48 33 50 12	Cedar Hammock.....	172 08 59	3361.9	3074.2	1.91
				Beach	213 49 30	3175.1	2903.4	1.80

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

33
38

S. Dec. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Oak Hammock.....	38 21 36.43	75 50 31.07	41 57 55 124 51 12	Cedar Hammock..... Brick Kiln Cove	221 57 16 304 50 22	2277.1 2366.5	2490.2 2587.9	1.42 1.47
Donoho	38 23 19.97	75 51 17.98	340 22 15 23 35 39	Oak Hammock..... Brick Kiln Cove	160 22 44 203 35 18	3389.1 2007.9	3706.2 2195.8	2.11 1.25
Sankey's Island	38 23 34.30	75 49 33.95	20 53 32 80 05 13	Oak Hammock. Donoho.	200 52 56 260 04 09	3889.4 2562.7	4252.3 2802.5	2.36 1.59
Windmill Hill	38 24 11.49	75 50 52.32	301 05 27 21 24 42	Sankey's Island	121 06 16 201 24 26	2220.5 1706.2	2428.3 1865.9	1.38 1.06
Red Oak Island	38 24 41.17	75 48 55.63	24 16 34 72 05 55	Sankey's Island	204 16 10 252 04 43	2261.8 2975.0	2473.4 3253.4	1.40 1.85
Nanticoke Manor.....	38 25 36.25	75 50 12.00	312 30 39 20 31 33	Red Oak Island..... Windmill Hill	132 31 27 200 31 08	2513.0 2790.3	2748.2 3051.4	1.56 1.73
Den Creek	38 25 44.80	75 48 44.77	7 39 06 82 54 34	Red Oak Island..... Nanticoke Manor.	187 38 59 262 53 40	1979.3 2131.8	2164.5 2331.3	1.23 1.32
Vickers	38 26 27.33	75 49 49.54	309 51 14 19 04 59	Den Creek	129 51 54 199 04 45	2046.8 1666.3	2237.4 1822.2	1.27 1.04
Gum Island.....	38 27 09.22	75 48 40.57	2 14 54 52 20 03	Den Creek	182 14 51 232 19 20	2604.6 2113.0	2848.3 2310.7	1.62 1.31
Point Pleasant	38 27 35.70	75 49 36.05	301 15 22 8 49 30	Gum Island	121 15 56 188 49 21	1573.5 2133.1	1720.7 2332.7	0.98 1.33
Barren Creek	38 27 52.50	75 47 54.45	39 57 47 78 08 14	Gum Island..... Point Pleasant.....	219 57 18 258 07 11	1740.7 2516.7	1903.6 2752.2	1.08 1.56

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

S. Doc. 3.

372

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Vienna.....	38 29 07.57	75 48 56.18	327 07 14 18 50 41	Barren Creek..... Point Pleasant.....	147 07 52 198 50 16	2756.0 2992.8	3013.9 3272.8	1.71 1.86
<i>Tangier Sound.</i>								
Solomon Evans	38 02 27.21	76 00 42.61	139 11 36 217 00 34	Holland..... Thomas	319 08 48 37 03 09	10148.8 10077.1	11098.4 11020.0	6.31 6.26
Jane's Island	37 58 30.03	75 53 37.33	125 12 58 164 23 05	Solomon Evans	305 08 36 344 21 16	12691.2 15946.2	13878.7 17438.3	7.89 9.91
Prickly Point.....	38 05 13.10	75 52 07.75	97 41 11 9 58 43	Holland..... Jane's Island	277 33 05 189 57 44	19347.2 12617.1	21157.5 13797.7	12.02 7.84
<i>SHANK'S HAMMOCK</i>								
Long Island	38 08 10.37	76 05 47.29	189 05 17 344 46 37	Bloodsworth	9 05 35 164 46 57	4447.5 3005.9	4863.7 3287.2	2.76 1.87
Jones.....	38 01 21.20	76 02 42.58	159 05 58 118 52 11	Holland..... Point No Point	339 04 24 298 42 06	10399.3 27290.0	11372.4 29843.5	6.46 16.96
Barn Point.....	37 59 50.29	75 58 47.61	149 54 41 288 04 21	Solomon Evans	329 53 30 108 07 32	5591.8 13931.4	6115.0 15235.0	3.48 8.66
Horse Hammock.....	37 57 08.94	75 59 18.65	215 06 37 253 16 01	Prickly Point..... Jane's Island	35 11 02 73 19 31	18250.0 8697.5	19957.7 9511.3	11.34 5.41
Fog Point Light.....	38 02 03.67	75 02 14.84	223 27 00 252 05 56	Thomas	43 30 31	12086.9	13217.9	7.51
				Solomon Evans	72 06 52	2363.1	2584.2	1.47

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

238

S. Dec. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Oak Hammock.....	38 21 36.43	75 50 31.07	41 57 55 124 51 12	Cedar Hammock..... Brick Kiln Cove	221 57 16 304 50 22	2277.1 2366.5	2490.2 2587.9	1.42 1.47
Donoho	38 23 19.97	75 51 17.98	340 22 15 23 35 39	Oak Hammock..... Brick Kiln Cove	160 22 44 203 35 18	3389.1 2007.9	3706.2 2195.8	2.11 1.25
Sankey's Island	38 23 34.30	75 49 33.95	20 53 32 80 05 13	Oak Hammock. Donoho.	200 52 56 260 04 09	3889.4 2562.7	4252.3 2802.5	2.36 1.59
Windmill Hill	38 24 11.49	75 50 52.32	301 05 27 21 24 42	Sankey's Island	121 06 16 201 24 26	2220.5 1706.2	2428.3 1865.9	1.38 1.06
Red Oak Island	38 24 41.17	75 48 55.63	24 16 34 72 05 55	Sankey's Island	204 16 10 252 04 43	2261.8 2975.0	2473.4 3253.4	1.40 1.85
Nanticoke Manor	38 25 36.25	75 50 12.00	312 30 39 20 31 33	Red Oak Island..... Windmill Hill	132 31 27 200 31 08	2513.0 2790.3	2748.2 3051.4	1.56 1.73
Den Creek	38 25 44.80	75 48 44.77	7 39 06 82 54 34	Red Oak Island..... Nanticoke Manor.	187 38 59 262 53 40	1979.3 2131.8	2164.5 2331.3	1.23 1.32
Vickers	38 26 27.33	75 49 49.54	309 51 14 19 04 59	Den Creek	129 51 54 199 04 45	2046.8 1666.3	2237.4 1822.2	1.27 1.04
Gum Island	38 27 09.22	75 48 40.57	2 14 54 52 20 03	Den Creek	182 14 51 232 19 20	2604.6 2113.0	2848.3 2310.7	1.62 1.31
Point Pleasant	38 27 35.70	75 49 36.05	301 15 22 8 49 30	Gum Island	121 15 56 188 49 21	1573.5 2133.1	1720.7 2332.7	0.98 1.33
Barren Creek	38 27 52.50	75 47 54.45	39 57 47 78 08 14	Gum Island..... Point Pleasant.....	219 57 18 258 07 11	1740.7 2516.7	1903.6 2752.2	1.08 1.56

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Metres.	Miles.
Vienna.....	38 29 07.57	75 48 56.18	327 07 14 18 50 41	Barren Creek..... Point Pleasant.....	147 07 52 198 50 16	3013.9 3272.8	2756.0 2992.8	1.71 1.86
<i>Tangier Sound.</i>								
Solomon Evans	38 02 27.21	76 00 42.61	139 11 36 217 00 34	Holland..... Thomas	319 08 48 37 03 09	11098.4 11020.0	10148.8 10077.1	6.31 6.26
Jane's Island	37 58 30.03	75 53 37.33	125 12 58 164 23 05	Solomon Evans	305 08 36 344 21 16	13878.7 17438.3	12691.2 15946.2	7.89 9.91
Prickly Point.....	38 05 13.10	75 52 07.75	97 41 11 9 58 43	Holland..... Jane's Island	277 33 05 189 57 44	21157.5 13797.7	19347.2 12617.1	12.02 7.84
SHANK'S HAMMOCK	37 55 15.59	76 02 09.48	.....	.....	.....	.....	.....	.....
Long Island	38 08 10.37	76 05 47.29	189 05 17 344 46 37	Bloodsworth	9 05 35 164 46 57	4863.7 3287.2	4447.5 3005.9	2.76 1.87
Jones.....	38 01 21.20	76 02 42.58	159 05 58 118 52 11	Holland..... Point No Point	339 04 24 298 42 06	11372.4 29843.5	10399.3 27290.0	6.46 16.96
Barn Point.....	37 59 50.29	75 58 47.61	149 54 41 288 04 21	Solomon Evans	329 53 30 108 07 32	6115.0 15235.0	5591.8 13931.4	3.48 8.66
Horse Hammock.....	37 57 08.94	75 59 18.65	215 06 37 253 16 01	Prickly Point..... Jane's Island	35 11 02 73 19 31	19957.7 9511.3	18250.0 8697.5	11.34 5.41
Fog Point Light.....	38 02 03.67	75 02 14.84	223 27 00 252 05 56	Thomas	43 30 31 72 06 52	13217.9 2584.2	12086.9 2363.1	7.51 1.47

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Little Bolton	38 01 47.25	75 49 39.74	43 33 51 150 23 34	Jane's Island	223 36 25	8400.5	9186.5	5.22
				Prickly Point	330 22 03	7300.0	7983.1	4.54
Crane Point.....	38 03 33.42	75 48 34.18	38 20 58 120 34 27	Jane's Island	218 17 51	11923.2	13038.9	7.41
				Prickly Point.....	300 32 15	6044.3	6609.9	3.76
Piny Island.....	38 06 28.09	75 54 58.09	48 32 14 299 06 32	Solomon Evans.....	228 28 42	11209.0	12275.8	6.96
				Prickly Point.....	119 08 18	4750.3	5194.8	2.95
St. Pierre.....	38 07 18.52	75 49 59.99	116 09 27 38 50 32	Turkey Point.....	296 05 19	10888.2	11907.0	6.77
				Prickly Point.....	218 49 13	4963.8	5428.3	3.08
Bluff, (Tree).....	38 05 20.38	76 00 50.38	270 57 48 109 58 57	Prickly Point.....	91 03 11	12736.3	13928.0	7.91
				Holland.....	289 56 14	6855.2	7496.7	4.26
Spring Island.....	38 07 54.13	76 03 36.83	44 52 06 337 08 43	Holland.....	224 51 06	3385.7	3702.5	2.10
				Solomon Evans	157 10 30	10936.3	11959.6	6.89
Cedar Hammock Point	38 06 28.27	76 02 44.06	338 16 16 154 07 12	Solomon Evans	158 17 31	7999.3	8747.8	4.97
				Spring Island.....	334 06 39	2942.5	3217.8	1.83
South Marshes.....	38 05 04.52	76 03 07.79	132 25 58 172 18 04	Holland.....	312 24 40	4194.3	4586.8	2.61
				Spring Island.....	352 17 46	5276.9	5770.7	3.28
Cold Quarter	38 09 07.38	76 01 24.75	50 17 15 355 14 23	Holland.....	230 14 53	7287.2	7969.1	2.53
				Solomon Evans	175 14 49	12379.5	13537.9	7.69
Pea Hill	38 07 39.67	76 21 25.11	309 02 43 274 38 37	Shank's Hammock.....	129 14 35	36337.8	39737.9	22.58
				Holland.....	94 48 36	23711.2	25929.9	14.73
Fox Island	37 53 52.70	75 54 14.52	102 27 45 31 54 45	Shank's Hammock	282 22 53	11879.0	12990.5	7.38
				Tangier	211 51 52	13030.2	14249.4	8.10

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

S. Doc. 3.

371

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Goose Harbor	37 52 01.51	75 59 53.21	150 55 14 247 28 20	Shank's Hammock	330 53 51	6346.8	7457.5	4.25
				Fox Island	67 31 48	8957.5	9795.7	5.57
TANGIER ISLAND	37 47 53.81	75 58 56.11	.....	.....	.....	.....	.....	.....
Pocomoke Bay.								
Beach Island	37 47 31.19	75 49 07.57	92 49 26 147 29 17	Tangier	272 43 25	14413.3	15762.0	8.95
				Fox Island	327 26 09	13950.4	15255.7	8.67
Woody Island	37 42 09.75	75 52 16.55	137 21 23 20 36 01	Tangier	317 17 18	14428.0	15778.0	8.96
				Sandy Point	200 33 34	16834.9	18410.1	10.46
Scott's Hall	37 44 27.41	75 49 22.37	114 25 46 183 39 26	Tangier	294 19 55	15414.0	16856.3	9.58
				Beach Island	3 39 35	5677.1	6208.3	3.53
Watt's Island	37 48 51.98	75 53 15.92	77 52 00 171 13 20	Tangier	257 48 31	8511.5	9307.9	5.29
				Fox Island	351 12 45	9380.5	10258.2	5.83
Watt's Island Light	37 46 52.62	75 53 17.80	102 52 09 258 59 16	Tangier	282 48 42	8488.6	9282.9	6.28
				Beach Island	79 01 50	6235.9	6819.4	3.88
Sykes Island	37 55 09.44	75 43 30.31	30 17 43 81 30 10	Beach Island	210 14 16	16356.5	17887.0	10.16
				Fox Island	261 23 35	15911.7	17400.6	9.89
Watermelon Hammock	37 56 32.46	75 50 08.58	125 26 42 284 42 25	Jane's Island	305 24 25	6252.9	6838.0	3.89
				Sykes Island	104 46 37	10055.8	10996.7	6.25
Tunnel's Island	37 53 53.88	75 45 21.86	25 05 11 229 27 39	Beach Island	205 02 52	13024.6	14243.3	8.09
				Sykes Island	49 28 48	3585.3	3920.8	2.23

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Maremscot.....	37 58 21.93	75 42 08.01	18 42 48 29 49 07	Sykes Island	198 41 58	6265.1	6851.3	3.89
Guildford Island.....	37 50 36.16	75 42 14.99	167 40 57 143 10 33	Tunnel's Island	209 47 08	9523.5	10414.7	5.92
Deep Creek Island	37 47 31.61	75 45 08.07	89 53 37 216 58 10	Sykes Island	347 40 10	8623.3	9430.2	5.36
Watkins' Point	37 56 51.18	75 48 02.83	295 12 43 324 15 59	Tunnel's Island	323 08 38	7616.4	8329.1	4.73
Kellum	37 40 03.28	75 51 35.85	143 25 18 194 43 07	Beach Island	269 51 10	5859.3	6407.6	3.64
Chesapeake Bay, Western Shore.				Guildford Island	36 39 56	7091.5	7755.1	4.41
Abell	38 16 52.88	76 23 09.17	189 18 32 228 02 32	Sykes Island	145 15 31	7356.3	8044.6	4.57
Tarleton	38 14 07.48	76 23 11.96	261 05 45 197 14 18	Tunnel's Island	144 17 38	6732.6	7362.6	4.18
Point No Point.....	38 09 27.45	76 19 04.11		Tangier	323 20 49	18071.8	19762.8	11.23
Point Look-out	38 02 44.74	76 19 04.86	180 06 13 250 29 24	Beach Island	14 44 38	14277.2	15613.1	8.87
Point Look-out Light.....	38 02 15.75	76 19 01.49	174 42 43 248 11 26	Tom's Point	97 26 07	18005.5	19690.3	11.19
				Cedar Point	48 03 25	2823.1	3087.3	1.75
				Tom's Point	81 13 22	18146.3	19844.3	6.80
				Cedar Point	17 15 13	7315.3	7999.8	4.54
				Point No Point.....				
				Holland	0 06 13	10565.4	11554.0	6.56
					70 37 55	21449.4	23456.4	13.33
				Point Look-out	354 42 41	897.9	981.9	0.55
				Holland	68 19 56	21678.2	23716.5	13.43

United States Coast Survey.—Geographical Positions: Section III.—Chesapeake Bay, Sketch C.

S. Doc. 3.

373

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Taylor.....	38 03 25.02	76 19 05.39	180 11 34 253 41 00	Point No Point..... Holland.....	0 11 35 73 49 32	9323.9 21078.9	10196.3 23051.2	5.79 13.10
Point Look-in.....	38 05 52.39	76 19 30.79	187 44 25 266 12 46	Point No Point..... Holland.....	7 44 42 86 21 34	4824.4 20894.2	5275.9 22849.3	3.00 12.98
SMITH'S POINT LIGHT.....	37 53 14.59	76 13 58.30	.....	.....	.....	.....	.....	.....
Hack's Neck	37 54 37.30	76 15 38.93	168 57 21 214 25 28	Point No Point..... Holland.....	348 55 15 34 31 53	26077.7 26889.1	28517.8 29405.1	16.20 16.71
Hull's Neck	37 56 57.16	76 20 48.81	193 18 09 276 26 27	Point Look-out .. Shank's Hammock.....	13 19 13 96 37 55	11011.8 27509.1	12042.2 30083.1	6.84 17.09
Fleet's Point	37 48 44.35	76 16 40.51	358 22 05 273 20 03	Windmill Point .. Tangier Island.....	178 22 21 93 30 56	22282.9 26081.1	24367.9 28521.5	13.85 16.21
Spry's Hill	37 52 14.20	76 18 40.59	256 54 39 254 52 19	Shank's Hammock..... Smith's Point Light	77 04 48 74 55 12	24849.7 7145.3	27174.9 7813.9	15.44 4.44
Taskmaker	37 50 00.78	76 14 37.90	189 12 12 241 58 59	Smith's Point Light .. Shank's Hammock.....	9 12 37 62 06 39	6052.7 20703.7	6619.1 22640.9	3.76 12.86
Doctor Hudnell.....	37 47 37.15	76 20 26.74	196 53 42 263 57 28	Spry's Hill .. Tangier Island.....	16 54 47 89 10 39	8926.6 31576.3	9761.9 34530.9	5.55 19.62
Damerone's Marsh	37 46 55.59	76 17 32.30	170 21 21 200 42 08	Spry's Hill .. Fleet's Point	350 20 39 20 42 40	9962.9 3584.3	10895.1 3919.7	6.19 2.23
Bluff Point	37 41 16.45	76 17 43.54	18 15	Fleet's Point .. Tangier Island.....	6 22 56 66 09 45	13893.9 30196.0	15194.0 33021.4	8.63 18.76

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Nantepoison	37 38 25.59	76 17 32.63	183 49 27 237 15 30	Fleet's Point	3 49 59	19117.7	20906.6	11.88
				Tangier Island.....	57 26 53	32471.4	35509.7	20.18
Hughlett's Neck	37 43 41.50	76 17 59.04	191 37 34 254 21 45	Fleet's Point.....	11 38 22	9532.2	10424.1	5.92
				Tangier Island.....	74 33 25	29032.9	31749.5	18.04
WINDMILL POINT.....	37 36 41.82	76 16 14.63	186 12 41.9 230 45 04.6	Smith's Point Light-house....	6 14 05.4	30786.3	33667.0	19.13
				Tangier Island.....	50 55 39.8	32804.5	35874.0	20.37
Stingray	37 33 35.14	76 17 21.72	195 57 12 269 42 09	Windmill Point	15 57 53	5985.6	6545.7	3.72
				Sandy Point	89 54 59	31013.9	33915.9	19.27
Cherry Point	37 31 00.36	76 17 26.91	189 33 28 260 59 56	Windmill Point	9 34 12	10674.6	11673.4	6.63
				Sandy Point	81 12 50	31529.0	34479.1	19.59
Gwynn's Island	37 28 21.76	76 15 14.82	174 33 52 250 37 36	Windmill Point	354 33 15	15485.1	16934.1	9.62
				Sandy Point	70 49 09	29573.7	32340.8	18.33
WOLF TRAP	37 24 00.73	76 14 24.22	173 25 22 236 11 32	Windmill Point	353 24 15	23617.6	25827.5	14.67
				Sandy Point	56 22 33	32085.4	35375.0	20.38
New Pt. Comfort Light-house	37 17 59.06	76 16 22.01	.....	.....	.....	.....	.....	.....
Cape Henry Light-house	36 55 28.63	76 00 11.55	.....	.....	.....	.....	.....	.....
Old Pt. Comfort Light-house.	37 00 02.10	76 18 05.68	.....	.....	.....	.....	.....	.....
Smith's Island Light-house...	37 07 47.67	75 52 12.06	.....	.....	.....	.....	.....	.....
SANDY POINT	37 33 33.48	75 56 17.92	.....	.....	.....	.....	.....	.....

United States Coast Survey.—Geographical Positions. Section III.—Chesapeake Bay. Sketch C.

S. Doc. 3.

375

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Nandua	37 36 44.38	75 54 36.93	89 58 04 198 55 17	Windmill Point	269 44 52	31823.8	34801.6	19.77
Heath	37 31 12.21	75 56 49.79	109 40 06 189 50 30	Woody Island	18 56 43	10604.0	11596.2	6.59
Bay View	37 28 36.87	75 57 37.14	118 41 10 191 48 35	Windmill Point	289 28 16	30335.4	33173.9	18.85
Naswaddox	37 26 36.07	75 58 17.76	189 50 30	Sandy Point	9 50 49	4576.5	5004.7	2.84
Rosemary	37 19 54.83	76 00 29.21	118 41 10 191 48 35	Windmill Point	298 29 49	31238.6	34161.6	19.41
COAST SOUTH OF CAPE HENLOPEN.			78 41 19 192 43 34	Sandy Point	11 49 23	9499.1	10387.9	5.90
Cape Henlopen	38 46 45.11	75 04 45.55		Wolf Trap	258 31 32	24240.9	26509.1	15.06
Lewes Entrance	38 48 48.24	75 11 32.41		Sandy Point	12 44 47	13350.1	14599.3	8.29
Burton's Tripod	38 42 36.69	75 09 18.64	220 48 06 164 15 58					
Rehoboth Beach	38 41 11.92	75 04 03.73	174 31 15 108 59 04	Cape Henlopen	40 50 58	10122.8	11070.0	6.29
Angola	38 38 54.73	75 07 13.34	227 16 44 156 08 30	Lewes Entrance	344 14 34	11904.0	13017.9	7.40
Long Neck	38 37 26.65	75 05 53.24	144 30 31 200 51 23	Cape Henlopen	354 30 49	10320.7	11286.4	6.41
				Burton's Tripod	388 55 47	8040.0	8792.3	5.00
				Rehoboth Beach	47 18 43	6236.9	6820.5	3.88
				Burton's Tripod	336 07 12	7483.5	8183.7	4.65
				Angola	324 29 41	2335.7	2554.3	1.45
				Rehoboth Beach	20 52 31	7433.2	8128.7	4.62

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.
Rehoboth Marsh	38 38 49.43	75 03 53.62	91 57 22 176 48 59	Angola..... Rehoboth Beach.....	271 55 17 356 48 53	4831.8 4400.2	5283.9 4811.9
Indian River Inlet.....	38 36 19.55	75 03 18.74	173 07 19 130 09 30	Rehoboth Beach..... Angola.....	353 06 51 310 07 04	9079.9 7442.1	9929.5 8116.6
Salt Works.....	38 35 35.20	75 03 14.49	131 50 11 175 42 13	Long Neck..... Indian River Inlet.....	311 48 32 355 42 10	5135.5 1371.3	5616.0 1599.6
Mouth of White Creek.....	38 35 19.12	75 06 10.49	263 20 45 186 03 16	Salt Works..... Long Neck.....	83 22 35 6 03 26	4287.4 3954.2	4688.6 4324.2
Burton's Island	38 36 43.56	75 04 55.53	310 45 52 34 51 56	Salt Works..... Mouth of White Creek	130 46 55 214 51 10	3227.8 3173.0	3529.8 3469.9
Laws	38 34 27.76	75 04 27.72	220 26 08 159 26 38	Salt Works..... Long Neck.....	40 26 54 339 25 45	2731.9 5891.1	2987.5 6442.3
Allen	38 34 30.28	75 03 08.53	175 52 37 87 40 54	Salt Works..... Laws	355 52 33 267 40 05	2006.5 1918.2	2194.3 2097.7
Holland's Hammock.....	38 33 27.57	75 04 13.94	219 18 38 169 48 43	Allen	39 19 19	2499.0	2732.8
Salt Pond Beach	38 33 21.39	75 03 04.97	135 37 03 96 31 13	Laws	349 48 35	1885.3	2061.7
Hall's Beach	38 32 25.62	75 02 56.16	172 55 36 135 24 24	Holland's Hammock.....	315 36 12 276 30 30	2863.5 1680.6	3131.4 1837.9
Evans	33 32 20.76	75 04 00.31	264 28 34 215 37 48	Salt Pond Beach..... Holland's Hammock.....	352 55 30 315 23 40	1732.5 2682.5	1894.6 2933.5
				Hall's Beach	84 29 14	1560.6	1706.6
				Salt Pond Beach.....	35 38 23	2300.0	2515.2
							0.97
							1.43

United States Coast Survey.—Geographical Positions. Section III.—Coast South of Cape Henlopen. Sketch C.

S. Doc. 3.

377

Name of station.	Latitude. O ' "	Longitude. O ' "	Azimuth. O ' "	To station—	Back azimuth. O ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Holland.....	38 33 23.95	75 04 52.37	168 52 06 210 20 12	Long Neck..... Salt Works.....	348 51 28 30 21 13	7626.7 4688.9	8340.2 5127.6	4.74 2.91
Hall's Fishery.....	38 31 50.21	75 02 52.15	175 32 34 134 48 19	Salt Works..... Holland.....	355 32 20 314 47 04	6957.8 4102.1	7608.8 4485.9	4.32 2.55
Tunnel.....	38 30 43.62	75 04 31.23	174 05 24 229 26 48	Holland..... Hall's Fishery.....	354 05 11 49 27 49	4969.7 3158.3	5434.7 3453.8	3.09 1.96
Daisy Marsh.....	38 29 02.84	75 02 46.55	140 47 03 178 29 43	Tunnel..... Hall's Fishery.....	320 45 58 358 29 40	4010.9 5161.9	4386.2 5644.9	2.49 3.21
Rodger.....	38 28 06.83	75 04 31.40	180 02 53 235 47 33	Tunnel..... Daisy Marsh.....	0 02 53 55 48 38	4834.0 3072.4	5286.3 3359.9	3.00 1.91
Fenwick.....	38 26 42.55	75 02 41.70	134 20 54 178 26 37	Rodger..... Daisy Marsh.....	314 19 46 358 26 34	3718.2 4327.1	4066.1 4732.0	2.31 2.69
Riley.....	38 25 22.04	75 06 07.91	243 28 26 204 29 46	Fenwick..... Rodger.....	63 30 34 24 30 46	5561.2 5583.7	6081.6 6106.2	3.46 3.47
Brig Knots.....	33 24 13.27	75 03 21.14	191 44 19 117 48 59	Fenwick..... Riley.....	11 44 43 297 47 16	4700.8 4545.9	5140.7 4971.3	2.92 2.83
Wight.....	33 23 27.67	75 05 41.65	170 08 28 247 34 44	Riley..... Brig Knots.....	350 08 12 67 36 11	3578.9 3687.5	3913.8 4032.5	2.23 2.29
Beach House.....	33 20 58.98	75 04 08.16	153 40 33 190 46 48	Wight..... Brig Knots.....	333 39 35 10 47 18	5115.7 6098.0	5594.4 6668.6	3.18 3.79
Davis.....	38 20 25.08	75 06 02.14	185 02 56 249 18 39	Wight..... Beach House.....	5 03 09 69 19 50	5651.6 2958.2	6180.4 3235.0	3.51 1.84

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	
						Metres.	Yards.
	° ' "	° ' "	° ' '		° ' "	Miles	Miles
Dromedary	38 18 59.37	75 05 08.01	201 30 45 153 33 32	Beach House	21 31 22 333 32 58	3963.4 2951.4	4334.3 3227.6
Quilling	38 18 10.42	75 06 43.56	193 37 01 236 57 22	Davis	13 37 27 56 58 21	4271.9 2768.5	4671.6 3027.6
Flat Mound	38 17 09.07	75 06 05.77	202 25 01 154 06 50	Dromedary	22 25 37 334 06 26	3378.9 2102.6	4023.1 2299.4
Ship Yard	38 16 27.85	75 07 53.05	208 05 42 244 00 21	Quilling	28 06 25 64 01 27	3584.8 2900.2	3920.2 3171.6
Twin Hills	38 14 54.66	75 07 23.63	204 32 28 166 01 38	Flat Mound	24 33 16 346 01 20	4555.5 2960.7	4981.8 3237.7
Powell	38 14 22.22	75 09 31.67	252 10 38 211 44 55	Twin Hills	72 11 57 31 45 57	3269.9 4555.3	3575.9 4981.6
North Birch	38 12 17.35	75 08 47.98	164 34 32 202 55 12	Powell	344 34 05 22 56 05	3993.8 5266.1	4367.5 5758.8
South Point Island	38 12 14.59	75 11 20.24	268 40 25 213 51 28	North Birch	88 41 59 33 52 36	3705.2 4738.8	4051.9 5182.2
South Birch	38 09 15.33	75 10 08.51	162 56 10 199 41 09	South Point Island	342 55 27 19 42 00	5781.3 5960.1	6322.3 6517.8
Robins' Marsh	38 09 11.98	75 14 33.14	269 19 44 219 57 42	South Birch	89 22 26 39 59 41	6394.1 7306.6	6992.4 7990.3
Green Run	38 04 53.41	75 11 51.42	153 48 28 196 55 19	Robins' Marsh	333 46 48 16 56 21	8919.3 8410.7	9753.9 9230.5
				South Birch			5.54 5.25

United States Coast Survey.—Geographical Positions.

Section III.—Coast South of Cape Henlopen.

Sketch C.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Mctres.	Yards.	Miles.
Big Bay Point	33 04 56.52	75 16 58.20	270 42 26	Green Run.....	90 45 36	7476.4	8176.0	4.65
			204 03 57	Robins' Marsh	24 05 26	8560.3	9470.7	5.33
Pope's Island Beach.....	33 01 24.23	75 14 23.73	209 55 36	Green Run.....	29 57 10	7549.5	8255.9	4.69
			150 05 38	Big Bay Point	330 04 03	7440.2	8136.4	4.62
Hardy's Hole Island.....	38 01 52.73	75 18 56.51	277 29 27	Pope's Island Beach.....	97 32 15	6709.7	7337.5	4.17
			206 57 55	Big Bay Point	26 59 08	6357.6	6952.5	3.95
Lonesome Hill.....	37 58 45.79	75 16 48.12	151 29 32	Hardy's Hole Island.....	331 28 13	6559.3	7173.1	4.08
			215 46 38	Pope's Island Beach.....	35 48 07	6023.3	6586.9	3.74
Snead	37 58 18.18	75 25 51.43	266 16 57	Lonesome Hill.....	86 22 31	13286.0	14529.2	8.26
			236 48 11	Hardy's Hole Island.....	56 52 26	12091.5	13222.9	7.51
Assateague light-house (vane)	37 54 37.22	75 21 03.64	134 08 22	Snead	314 05 25	9786.2	10701.9	6.08
			219 07 43	Lonesome Hill.....	39 10 20	9881.2	10805.8	6.14
Assateague light-house (signal.)	37 54 37.27	75 21 03.60	134 08 14	Snead	314 05 17	9784.6	10700.2	6.08
			219 08 17	Lonesome Hill.....	39 10 54	9881.8	10805.4	6.14
Wallop's Island.....	37 52 25.04	75 25 51.12	239 50 38	Assateague Light, (signal)....	59 53 34	8119.6	8879.4	5.05
			179 57 42	Snead	359 57 41	10886.7	11905.4	6.76
Taylor	37 52 32.34	75 29 28.11	272 24 47	Wallop's Island.....	92 27 00	5307.1	5803.7	3.20
			206 22 35	Snead	26 24 48	11902.7	13016.5	7.39
Sheep-pen Flat	37 57 31.03	75 17 36.11	96 53 59	Snead	276 43 54	12176.4	13315.8	7.57
			43 26 04	Assateague Light, (signal)....	223 23 56	7374.7	8064.8	4.58
Assawoman Inlet.....	37 49 58.95	75 28 49.54	168 43 50	Taylor	348 43 26	4821.8	5273.0	3.00
			224 03 57	Wallop's Island.....	44 05 46	6270.1	6856.8	3.90

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Nack	37 49 28.21	75 31 42.59	210 04 07 257 21 54	Taylor	30 05 29	6559.6	7173.4	4.03
				Assawoman Inlet.....	77 23 40	4336.2	4741.9	2.69
Mèran	37 47 45.05	75 30 29.70	150 43 55 210 40 49	Nack	330 43 10	3645.8	3986.9	2.27
				Assawoman.....	30 41 50	4799.8	5248.9	2.93
Britnam	37 46 55.07	75 32 48.73	198 54 45 245 37 06	Nack	18 55 25	4990.6	5457.6	3.10
				Mèran	65 38 31	3734.1	4083.5	2.32
South Gargathy	37 45 20.21	75 31 50.46	203 52 09 154 00 44	Mèran	23 52 59	4883.1	5340.0	3.03
				Britnam.....	334 00 08	3253.4	3557.8	2.02
Watson	37 44 15.85	75 34 47.80	245 25 24 210 41 22	South Gargathy	65 27 12	4773.1	5219.7	2.97
				Britnam	30 42 35	5708.4	6242.2	3.55
Matomkan	37 41 43.32	75 33 53.42	164 11 32 204 13 57	Watson	344 10 59	4887.0	5344.3	3.04
				South Gargathy.....	24 15 12	7332.8	8018.9	4.56
Joynes.....	37 41 47.88	75 36 28.70	208 26 08 272 06 11	Watson	28 27 09	5187.8	5673.2	3.22
				Matomkan	92 07 46	5806.2	4162.4	2.37
Cedar Island	37 39 24.40	75 34 46.62	150 31 23 196 55 33	Joynes.....	330 30 21	5081.2	5556.7	3.16
				Matomkan	16 56 05	4476.6	4895.5	2.78
Custis	37 39 15.31	75 38 14.48	208 51 00 266 50 01	Joynes.....	28 52 05	5370.1	5872.6	3.34
				Cedar Island	86 52 08	5102.3	5579.7	3.17
Horse-shoe	37 37 03.60	75 35 36.71	136 24 17 195 47 36	Custis	316 22 40	5607.7	6132.4	3.49
				Cedar Island	15 48 07	4511.1	4933.2	2.80
Haulover	37 37 03.07	75 40 00.13	212 25 18 269 50 06	Custis	32 26 23	4829.6	5281.5	3.00
				Horse-shoe	89 52 47	6459.5	7063.9	4.01

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Bodie's Isl'd Base { N. end. S. end.	35 53 56.56	0 35 32.90	156 28 48.0	North Base.....	336 27 06.9	10841.5	11855.9	6.735
	35 48 34.03	0 38 25.45						
Roanoke Marshes	35 48 44.59	0 29 19.82	224 12 03.8	North Base.....	44 15 42.3	13418.0	14373.5	8.33
			271 19 00.1	South Base.....	91 24 19.4	13700.3	14932.2	8.51
Bodie's Island, Astronomical Station.	35 47 31.30	0 39 27.53	98 28 13.0	Roanoke Marshes.....	278 22 17.5	15422.6	16865.7	9.58
			153 38 42.2	North Base.....	333 36 24.8	13252.3	14492.3	8.23
Mann's Point	35 53 14.44	0 31 23.83	321 49 50.3	North Base.....	141 52 16.5	10106.1	11051.7	6.27
			10 03 03.9	Roanoke Marshes.....	190 01 51.2	17835.0	19503.8	11.08
Robert's Fishery.....	35 56 06.08	0 24 26.03	331 32 10.9	Roanoke Marshes	151 35 03.1	15473.2	16921.0	9.61
			249 15 54.8	Mann's Point	69 20 00.1	11191.2	12238.3	6.95
Roden	36 00 10.93	0 27 35.91	302 08 48.8	Mann's Point	122 11 02.7	6743.4	7374.4	4.18
			32 14 33.1	Robert's Fishery	212 12 41.6	8920.1	9754.7	5.54
Shellbank	36 03 20.93	0 26 57.96	15 51 40.5	Robert's Fishery	195 50 11.2	13931.3	15234.8	8.65
			324 48 13.4	Mann's Point	144 50 49.7	11555.8	12637.0	7.17
Caroon's Point.....	35 57 23.77	0 23 02.18	350 46 41.9	Roden	170 47 03.9	5932.3	6487.4	3.69
			233 03 34.2	Roden	53 06 15.0	8576.2	9378.6	5.32
Powell's Point	36 04 18.83	E. 0 23 26.73	318 43 29.0	Robert's Fishery	138 44 18.2	3185.7	3483.7	1.97
			208 11 17.9	Shellbank	28 13 36.3	12490.6	13659.4	7.76
			262 52 37.2	Mann's Point.....	82 57 30.7	12664.8	13849.8	7.87
			320 45 09.0	Roden	140 47 35.1	98628.0	10785.6	6.12
			2 45 10.2	Caroon's Point.....	182 44 55.7	12806.2	14004.4	7.95
			354 24 34.5	Robert's Fishery.....	174 25 09.4	15258.7	16686.5	9.48
			258 38 22.1	Shellbank	108 40 26.4	5578.5	6100.5	3.47

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Tillet.....	36 06 04.40	E. 0 20 29.36	346 34 33.9 315 32 43.2	Carroon's Point..... Roden	166 36 03.8 135 36 54.2	16494.7 15252.0	18058.1 16679.1	10.24 9.47
East Durant Island.....	35 58 34.51	0 17 35.74	258 46 06.2 197 23 16.8 219 35 47.5	Roden	78 51 58.8	15323.4	16757.2	9.51
				Tillet.....	17 24 58.9	14530.2	15889.8	9.02
				Powell's Point	39 39 15.0	13777.6	15066.8	8.56
Pear-tree Point	35 59 05.60	0 08 30.44	273 58 07.2 234 17 21.9	East Durant Island..... Tillet	94 03 27.5 54 24 24.9	13692.6 22144.0	14973.8 24216.0	8.50 13.75
Wade's Bluff	36 08 13.32	E. 0 06 54.63	351 54 29.8 280 58 10.8	Pear-tree Point	171 55 26.2	17049.6	21220.8	12.05
				Tillet	101 06 11.1	20756.0	14739.1	8.37
Reed's Point	36 05 42.58	W. 0 01 31.33	309 02 09.7 249 47 44.3	Pear-tree Point	129 08 03.8	19405.1	18644.9	10.59
				Wade's Bluff	69 52 42.5	13478.0	22698.1	12.89
Palmetto.....	35 59 42.31	E. 0 02 33.47	202 30 48.8 151 07 45.6	Wade's Bluff	22 33 22.6	17050.9	18646.3	10.59
				Reed's Point	331 05 21.5	12681.5	13868.1	7.89
Stevenson's Point	36 06 18.21	E. 0 00 00.00	342 30 51.9 251 04 32.9	Palmet o.....	162 32 22.2	12791.6	13988.5	7.94
				Wade's Bluff.....	71 08 37.4	10957.6	11982.9	6.80
Brick House	35 59 12.20	W. 0 01 08.05	177 13 44.7 215 52 28.4	Reed's Point.....	357 13 31.0	12045.1	13172.1	7.48
				Wade's Bluff.....	35 57 12.5	29591.1	22518.2	12.79
Batt's Grove	36 04 04.23	W. 0 11 47.41	299 17 49.3 258 49 26.0	Brick House	119 24 05.3	18362.5	20080.6	11.40
				Reed's Point	78 55 28.8	15707.5	17177.3	9.77
Laurel Point	35 59 03.48	W. 0 12 29.60	269 02 32.6 186 29 50.1	Brick House..... Batt's Grove.....	89 09 13.0 6 30 14.9	17072.9 9328.8	18670.4 10201.7	10.61 5.79

United States Coast Survey.—Geographical Positions. Section IV.—Primary Stations. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.	Miles.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.		
Leary	36 01 22.97	W. 0 16 23.29	234 13 54.4 306 16 58.4	Batt's Grove..... Laurel Point.....	54 16 36.7 126 19 15.8	8507.3 7261.2	9303.3 7940.6		5.28 4.51
Sleepy Hole.....	35 58 42.49	0 14 07.41	199 27 17.6 145 28 54.4	Batt's Grove..... Leary	19 28 39.9 325 27 34.5	10516.8 6003.3	11500.8 6565.0		6.53 3.73
Sleight.....	35 57 33.92	0 18 00.47	199 00 53.6 250 04 56.4	Leary	19 01 50.7	7467.0	8165.6		4.63
Sandy Point	36 00 22.09	0 19 27.07	247 48 05.6 337 16 55.2 290 57 03.4	Sleepy Hole..... Leary	70 07 13.3	6209.4	6790.4		3.85
Mackay's Creek.....	36 56 27.13	0 24 40.85	258 22 27.6 227 19 21.7	Sleight..... Sandy Point	67 49 53.7 157 17 46.1 111 00 10.9	4969.3 5613.6 8574.2	5434.3 6144.3 9376.5		3.08 3.49 5.33
Hornblower's Point.....	36 00 42.13	0 23 32.85	275 42 41.6 12 14 07.2 304 50 24.9	Sandy Point	78 26 22.7	10241.7	11200.0		6.36
Williams.....	35 56 11.25	0 26 53.90	261 38 18.8	Mackay's Creek.....	47 22 26.0	10687.3	11687.3		6.64
Capeheart.....	35 59 07.79	0 29 43.66	252 35 02.3 321 58 11.1 303 06 15.1	Sandy Point	95 45 06.1 192 13 27.3 124 53 39.5	6185.1 8041.3 10145.8	6763.9 8793.6 11095.2		3.84 5.00 6.30
Black Walnut Point.....	36 00 12.01	W. 0 29 42.43	264 14 31.1 330 20 46.6 312 30 25.0	Hornblower's Point..... Williams	31 07 08.9 81 39 36.9	9749.8 3370.3	10662.0 3685.6		6.06 2.10
				Mackay's Creek	72 38 40.3 141 59 50.8 123 09 13.9	9730.7 6905.9 9059.3	10641.2 7552.1 9907.0		6.04 4.29 5.63
				Hornblower's Point.....	84 18 08.4 150 22 25.6 132 33 22.1	9300.8 8537.1 10252.4	10171.1 9335.9 11211.7		5.77 5.30 6.37

United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
East Chowan	36 02 08.01	W. 0 27 54.54	291 58 86.9 352 07 49.6 37 04 59.8	Hornblower's Point..... Williams..... Black Walnut Point.....	112 01 10.8 172 08 25.2 217 03 56.5	7065.8 11099.3 4480.6	7727.0 12137.8 4899.9	4.44 6.89 2.78
ALBEMARLE SOUND.								
Haulover.....	35 58 43.56	E. 0 19 10.89	92 28 33 188 13 08	Pear-tree Point..... Tillet.....	272 22 20 8 13 59	16056.5 13727.3	17558.9 15011.8	9.97 8.52
North River Point.....	36 09 47.44	0 16 50.64	32 21 39 356 52 55	Pear-tree Point..... East Durant Island.....	212 16 44 176 53 21	23407.1 20769.8	25597.2 22713.3	14.54 12.90
West Durant Island.....	35 57 34.72	0 14 27.92	107 23 46 209 54 49	Pear-tree Point..... Tillet.....	287 20 16 29 58 21	9382.9 18127.1	10260.9 19823.3	5.83 11.28
Long Shoak.....	35 57 38.09	0 10 24.53	260 49 16 224 05 13	East Durant Island..... Tillet.....	80 53 29 44 11 08	10941.8 20174.2	11965.6 23776.3	6.79 13.50
East North River	36 07 42.08	0 19 22.03	93 00 40 45 44 31	Wade's Bluff..... Pear-tree Point.....	272 53 19 225 38 07	18709.3 22787.7	20459.9 24917.7	11.62 14.15
East Pasquotank.....	36 09 56.19	0 15 07.48	75 36 28 26 23 13	Wade's Bluff..... Pear-tree Point.....	255 31 38 296 19 19	12720.0 22376.2	13910.2 24469.9	7.90 13.90
West Pasquotank	36 09 08.01	0 08 03.39	357 54 36 261 59 27	Pear-tree Point..... East Pasquotank.....	177 54 52 82 03 37	18578.1 10702.3	20316.5 11703.7	11.54 6.64
Davenport.....	35 59 31.41	0 06 54.80	179 58 50 132 07 20	Wade's Bluff..... Reed's Point.....	359 58 50 312 02 22	16085.6 17069.4	17590.7 18666.5	9.99 10.60
Flatty Creek	36 07 45.63	E. 0 04 17.79	9 56 56 66 32 44	Palmetto..... Reed's Point	189 55 55 246 29 18	15123.4 9519.1	16538.5 10409.8	9.39 5.91

United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound. Sketch D.

S. Doc. 3.

385

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Leigh's Mills.....	35 59 27.55	E. 0 03 21.99	185 11 26 147 35 56	Flatty Creek.....	5 11 58	15414.9	16857.3	9.57
Ship Point.....	35 59 40 62	0 01 13.60	197 07 08 159 42 18	Reed's Point.....	327 33 03	13693.2	14974.5	8.50
East Little River.....	36 07 23.59	E. 0 01 42.85	57 20 50 354 57 15	Flatty Creek.....	17 08 56	15643.2	17106.9	9.71
Jacock's Point.....	36 06 58.35	W. 0 01 10.81	304 56 04 12 23 57	Reed's Point.....	339 40 41	11895.3	13008.4	7.39
Harvey's Neck.....	36 05 24.44	0 07 16.27	266 15 52 321 11 30	Palmetto.....	237 18 56	5768.7	6308.5	3.58
Westcott's Mill.....	35 59 14.02	0 00 27.46	138 09 41 172 23 50	Reed's Point.....	174 54 45	14273.5	15609.1	8.87
Alexander's Mill.....	35 58 25.94	0 04 16.18	160 44 55 197 01 52	Stevenson's Point.....	124 56 45	2160.0	2362.2	1.34
Barrow.....	36 04 49.48	0 11 32.24	303 34 49 263 44 12	Reed's Point.....	192 23 45	2391.1	2614.8	1.49
Run Point.....	35 58 19.81	0 04 56.53	140 30 39 200 36 30	Reed's Point.....	86 19 15	8645.9	9454.8	5.37
Bull Point.....	35 57 16.12	0 10 54.52	173 59 41 257 37 31	Harvey's Neck.....	141 15 07	14715.6	16092.6	9.14
Mill Point.....	35 56 44.25	W. 0 07 31.94	100 57 51 154 45 48	Reed's Point.....	318 05 41	15331.6	16766.1	9.53
				Reed's Point.....	352 23 13	12082.0	13212.5	7.50
				Harvey's Neck.....	340 43 09	13663.8	14942.3	8.50
				Reed's Point.....	17 03 29	14076.0	15393.0	8.74
				Brick House.....	123 40 56	18762.7	20518.3	11.65
				Reed's Point.....	83 50 06	15121.6	16536.5	9.40
				Barrow.....	220 26 47	15569.1	17025.9	9.67
				Reed's Point.....	20 38 31	14581.2	15945.6	9.05
				Batt's Grove.....	353 59 10	12648.2	13831.6	7.85
				Run Point.....	77 41 01	9181.4	10040.6	5.70
				Bull Point.....	280 55 52	5171.3	5655.2	3.21
				Batt's Grove.....	334 43 18	14994.1	16397.1	9.31

United States Coast Survey.—Geographical Positions. Section IV.—Albemarle Sound Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Metres.	Miles.
Nixon	36 06 14.28	W. 0 03 53.02	342 22 38 73 12 11	Brick House.....	162 24 15	14924.6	13647.6	8.47
				Harvey's Neck.....	253 10 11	5807.5	5310.6	3.29
Burnham.....	36 06 03.20	0 03 07.79	79 08 22 346 40 47	Harvey's Neck.....	259 05 56	6921.0	6328.9	3.93
				Brick House.....	166 41 58	14234.1	13016.2	8.08
Edenton.....	36 02 46.95	0 24 50.59	47 23 23 14 13 09	Capeheart.....	227 20 29	10906.9	9973.4	6.20
				Williams.....	194 11 55	13757.9	12580.7	7.82
Edenton Court-house.....	36 03 27.45	0 25 04.62	41 08 15 11 30 48	Capeheart.....	221 05 32	11617.2	10623.0	6.60
				Williams.....	191 29 44	15002.9	13719.6	8.52
Bluff Point.....	36 01 34.13	0 16 09.86	310 04 05 234 49 27	Laurel Point.....	130 06 15	7884.4	7209.8	4.48
				Batt's Grove.....	54 52 02	8786.1	8034.4	4.99
Benbury.....	36 03 21.53	0 14 16.58	40 35 37 341 22 36	Bluff Point	220 34 31	4766.4	4358.6	2.70
				Laurel Point.....	161 23 39	9177.0	8391.8	4.21
Smith's Mill	35 57 12.25	0 18 34.95	167 26 17 203 04 56	Sandy Point	347 25 46	6562.4	6000.9	3.72
				Leary	23 06 13	9193.7	8407.1	5.22
Lewis Island.....	35 58 20.46	0 15 19.05	121 10 12 164 03 22	Sandy Point.....	301 07 47	7938.2	7259.0	4.50
				Leary	344 02 44	6404.6	5856.6	3.63
Sleight's Mill	35 57 34.69	0 17 04.27	145 18 32 188 17 14	Sandy Point.....	325 17 08	6871.0	6283.1	3.90
				Leary.....	8 17 38	7781.9	7116.1	4.42
Armistead Fishery	35 56 30.81	W. 0 21 16 05	156 08 43 200 56 42	Hornblower's Point.....	336 07 22	9262.9	8470.4	5.26
				Sandy Point	20 57 44	8347.3	7633.1	4.74

United States Coast Survey.—Geographical Positions. Section IV.—Pasquotank River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
PASQUOTANK RIVER.								
Bluff Point (2) 1848.....	36 11 43.34	E. 0 06 48.84	338 43 24 284 48 17	West Pasquotank	158 44 07	5137.2	5617.9	3.19
				East Pasquotank.....	104 53 11	12889.6	14095.7	8.00
Miles' Mill	36 12 34.10	0 08 48.43	10 02 46 62 22 11	West Pasquotank	190 02 20	6450.6	7054.2	4.00
				Bluff Point (2) 1848	242 21 01	3372.4	3687.9	2.09
Miller's Point.....	36 14 13.17	0 06 29.23	353 56 40 311 16 59	Bluff Point (2) 1848	173 56 51	4644.0	5078.5	2.89
				Miles' Mill	131 18 22	4627.2	5060.1	2.87
Bluff Point (1).....	36 12 29.30	0 05 50.47	196 49 09 268 04 34	Miller's Point.....	16 49 32	3344.9	3657.9	2.07
				Miles' Mill	88 06 19	4447.8	4864.0	2.76
Bluff Point (2) 1846	36 11 46.19	0 06 49 11	173 44 49 243 38 00	Miller's Point.....	353 44 38	4557.5	4983.9	2.83
				Miles' Mill	63 39 10	3326.6	3637.9	2.07
Wade's Point.....	36 09 21.63	0 07 56.41	159 19 29 192 21 13	Bluff Point (2) 1846	339 18 49	4762.5	5208.1	2.95
				Miles' Mill	12 21 43	6073.2	6641.5	3.77
Pocoson Point (1).....	36 11 24.27	0 10 04.43	40 15 07 97 53 45	Wade's Point.....	220 13 51	4952.2	7666.5	4.35
				Bluff Point (2) 1846	277 51 49	4926.4	9457.2	5.37
Pocoson Point (2).....	36 10 32.39	0 12 23.04	71 53 49 115 16 31	Wade's Point.....	251 51 11	7011.5	5415.5	3.07
				Bluff Point (2) 1846	285 13 13	8648.0	5387.3	3.06
Bank's Point	36 10 29.26	0 07 16.30	210 52 48 164 00 43	Miles' Mill	30 53 41	4483.8	4903.3	2.78
				Bluff Point (2) 1846	344 00 27	2466.4	2697.1	1.53
Harvey's Mill.....	36 12 56.16	E. 0 04 21.15	290 21 07 233 24 18	Bluff Point (1).....	110 21 58	2379.5	2602.1	1.48
				Miller's Point.....	53 25 34	3983.1	4355.8	2.48

United States Coast Survey.—Geographical Positions. Section IV.—Pasquotank River. Sketch D.

3388

S. Doc. 3.

Name of station	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Poole's Point	36 13 53.85	E. 0 03 56.90	312 33 57	Bluff Point (1).....	132 35 04	3851.8	4212.2	2.39
			261 05 07	Miller's Point.....	81 06 37	3850.2	4210.4	2.39
Bell's Mill.....	36 15 19.54	0 05 24.57	39 39 15	Poole's Point	219 38 23	3430.3	3751.2	2.13
			321 42 35	Miller's Point.....	141 43 14	2605.9	2849.7	1.61
Glover's Point	36 15 10.84	0 03 10.91	334 10 31	Poole's Point.....	154 10 58	2636.3	2883.0	1.63
			265 23 37	Bell's Mill.....	85 24 56	3347.3	3660.5	2.07
Dozier's Mill	36 16 48.76	0 04 06.84	24 49 27	Glover's Point	204 48 54	3325.4	3527.2	2.06
			324 47 25	Bell's Mill.....	144 48 11	3365.5	3680.4	2.09
Brick House Point	36 15 49.89	0 01 46.52	299 44 03	Glover's Point	119 44 52	2426.1	2653.1	1.50
			242 35 47	Dozier's Mill	62 37 10	3944.1	4313.1	2.45
Anson's Point.....	36 17 21.86	0 01 38.30	355 51 28	Brick House Point	175 51 33	2842.0	3107.9	1.77
			285 22 25	Dozier's Mill	105 23 53	3844.4	4204.1	2.39
Cobb's Point	36 17 14.26	E. 0 00 00.63	264 29 59	Anson's Point.....	84 30 57	2448.4	2677.5	1.52
			314 31 36	Brick House Point	134 32 38	3707.5	4054.4	2.30
Hospital Point.....	36 17 43.90	W. 0 00 22.88	327 17 20	Cobb's Point	147 17 34	1085.9	1187.5	0.67
			282 39 06	Anson's Point.....	102 40 18	3099.1	3389.0	1.92
Forbes' Mill.....	36 17 34.92	0 00 56.66	251 48 43	Hospital Point.....	71 49 03	887.1	970.1	0.55
			294 00 15	Cobb's Point	114 00 49	1565.0	1711.4	0.97
Elizabeth City Market Signal	36 17 57.30	0 01 41.70	301 32 13	Forbes' Mill.....	121 32 40	1318.5	1441.9	0.81
			281 51 01	Hospital Point.....	101 51 48	2009.5	2197.5	1.24
*Elizabeth City Court-house.	36 18 00.87	W. 0 01 56.13	.....	Market Signal .....	.....	376.4	411.6	0.23

United States Coast Survey.—Geographical Positions. Section IV.—Perquimons River. Sketch D.

S. Doc. 3.

389

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
PERQUIMONS RIVER.								
Blount's Point	36 07 14.24	W.0 09 24.15	316 36 06	Harvey's Neck.....	136 37 22	4656.5	5092.2	2.89
			282 33 07	Nixon's	102 36 22	8484.7	9278.6	5.27
Canaan Cove	36 08 05.65	0 08 36.34	37 01 54	Blount's Point	217 01 26	1984.9	2170.6	1.23
			338 02 20	Harvey's Neck.....	158 03 07	5357.1	5858.3	3.32
Grassy Point	36 08 17.02	0 11 00.01	308 54 16	Blount's Point	128 55 12	3080.5	3368.7	1.91
			275 33 34	Canaan Cove	95 34 59	3609.0	3946.6	2.24
Halsey Bay.....	36 07 51.75	0 11 47.90	287 49 01	Blount's Point	107 50 26	3775.9	4129.2	2.34
			236 57 01	Grassy Point	56 57 30	1428.4	1562.0	0.88
Robbins' Point.....	36 08 37.15	0 12 41.57	316 11 43	Halsey Bay.....	136 12 14	1938.5	2119.8	1.20
			283 43 09	Grassy Point.....	103 44 09	2613.5	2858.0	1.62
Old Neck	36 10 38.24	0 13 35.27	340 12 50	Robbins' Point.....	160 13 22	3957.2	4327.4	2.45
			318 15 59	Grassy Point.....	138 17 30	5831.3	6376.9	3.62
Barrow	36 10 30.64	0 15 04.26	263 58 28	Old Neck	83 59 21	2236.1	2445.3	1.38
			314 25 51	Robbins' Point.....	134 27 15	4995.5	5462.9	3.10
Skinner's Fishery	36 11 03.55	0 14 24.25	302 28 17	Old Neck	122 28 46	1452.9	1558.9	0.90
			44 31 41	Barrow	224 31 18	1423.0	1556.2	0.88
Ferry Point	36 11 33.53	W.0 15 51.18	328 49 51	Barrow	148 50 19	2265.4	2477.4	1.41
			293 03 15	Skinner's Fishery	113 04 07	2358.5	2579.2	1.47
LITTLE RIVER.								
Preliminary Base—South End	36 05 44.83	W.0 01 26.18	189 38 00	Jacock's Point.....	9 38 09	2298.2	2513.2	1.43
			244 28 54	Stevenson's Point.....	64 29 44	2388.4	2611.9	1.48

United States Coast Survey.—Geographical Positions. Section IV.—Little River. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Preliminary Base—North End	36 06 27.38	W. 0 01 41.97	343 14 55 276 19 05	South end of base	163 15 05	1369.5	1497.6	0.85
Mill Point.....	36 07 30.92	E. 0 00 07.31	62 48 14 4 39 35	Jacock's Point.....	242 47 34	2195.9	2401.4	1.33
Greaves' Landing	36 08 11.09	W. 0 00 52.52	11 31 32 309 36 27	Stevenson's Point	184 39 36	2248.3	2458.7	1.40
Newby's Landing.....	36 08 49.33	0 02 49.57	324 09 43 291 55 39	Jacock's Point.....	191 31 21	2287.9	2502.0	1.42
Banks	36 09 33.25	0 02 19.02	29 25 37 340 20 04	Mill Point.....	129 37 02	1941.7	2123.4	1.21
Birdsand	36 09 30.16	0 03 23.32	326 09 57 266 35 56	Jacock's Point.....	144 10 41	4218.6	4613.3	2.62
Long Point.....	36 10 28.37	0 03 29.77	354 51 27 313 51 02	Greaves' Landing	111 56 48	3154.6	3449.8	1.96
Deep Creek Point.....	36 10 44.48	0 04 46.62	317 43 35 284 28 58	Newby's Landing.....	209 25 19	1554.3	1699.7	0.97
Trueblood's Point.....	36 11 14.27	0 04 36.83	14 54 36 310 09 58	Jacock's Point.....	160 20 44	5069.6	5544.0	3.15
Nixonton.....	36 11 37.46	W. 0 05 12.12	309 46 23 338 40 47	Newby's Landing.....	146 10 17	1515.0	1656.8	0.94
				Banks	86 36 34	1609.7	1760.3	1.00
				Birdsand	174 51 31	1801.6	1970.2	1.12
				Banks	133 51 44	2452.1	2681.6	1.52
				Birdsand	137 44 24	3095.2	3384.8	1.92
				Long Point.....	104 29 43	1983.2	2168.8	1.23
				Deep Creek Point.....	194 54 31	950.3	1039.2	0.59
				Long Point.....	130 10 36	2192.7	2397.9	1.36
				Long Point.....	129 47 23	3327.7	3639.1	2.07
				Deep Creek Point.....	158 41 02	1753.0	1917.0	1.09

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

S. Dec. 3.

391

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
ALLIGATOR RIVER.								
Sandy Point	35 55 24.93	E. 0 10 45.02	172 52 17 234 22 23	Long Shoal..... West Durant Island	352 52 05 54 24 34	4136.2 6870.7	4523.2 7513.6	2.57 4.27
South Durant.....	35 56 07.49	0 16 14.17	80 59 19 107 42 05	Sandy Point..... Long Shoal.....	260 56 06 287 38 40	8354.5 9196.2	9136.2 10056.7	5.19 5.71
Little Alligator	35 57 15.93	0 10 13.46	202 06 46 346 58 36	Long Shoal..... Sandy Point	22 06 53 166 58 55	737.4 3511.0	806.4 3839.5	0.46 2.18
Briery Hall.....	35 55 38.69	0 15 13.98	162 06 08 86 25 06	West Durant Island	342 05 41 266 22 28	3757.8 6755.8	4109.4 7387.9	2.33 4.20
A	35 55 08.25	E. 0 14 28.83	127 02 30 179 42 09	Long Shoal..... West Durant Island	307 00 07 359 42 09	7669.4 4514.3	8387.0 4936.7	4.76 2.79
B	35 54 16.01	E. 0 13 44.13	141 14 21 115 19 28	Long Shoal..... Sandy Point	321 12 24 295 17 43	7988.6 4967.6	8736.1 5432.4	4.96 3.08
Laurel Point	35 53 15.35	0 11 52.68	164 44 32 156 59 06	Long Shoal..... Sandy Point	344 43 40 336 58 27	8393.7 4338.9	9179.1 4744.9	5.21 2.69
Second Creek.....	35 52 12.71	0 08 45.95	206 44 03 247 34 38	Sandy Point..... Laurel Point.....	26 45 13 67 36 27	6634.2 5066.2	7255.0 5540.2	4.12 3.14
C	35 53 44.18	0 12 29.22	63 17 30 139 55 33	Second Creek	343 15 19 319 54 32	6269.6 4058.1	6856.2 4437.8	3.89 2.52
Y	35 54 08.63	E. 0 09 40.74	296 22 42 21 02 23	Laurel Point..... Second Creek	116 23 59 201 01 51	3693.6 3827.9	4039.2 4186.0	2.29 2.37

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
Lot Signal,	35 48 05.87	E. 0 08 24.76	183 59 37 208 39 26	Second Creek	3 59 50 28 41 27	7626.2 10872.0	8339.8 11889.3	4.73 6.75
X	35 51 01.43	0 07 44.20	236 27 48 304 35 53	Laurel Point	56 30 14 124 38 16	7476.0 7438.2	8175.5 8134.2	4.64 4.62
E	35 50 29.74	0 12 27.79	54 00 17 119 42 19	Lot Signal	233 57 55 299 40 09	7541.6 6407.2	8247.2 7006.7	4.68 3.98
D	35 52 04.02	0 11 50.12	35 05 19 93 19 41	Lot Signal	215 03 20 273 17 54	8968.6 4627.8	9807.8 5060.8	5.57 2.88
F	35 49 35.17	0 12 12.17	64 16 34 133 11 23	Lot Signal	244 14 21 313 09 22	6337.7 7095.9	6930.7 7759.9	3.94 4.41
W	35 49 39.53	0 07 44.38	223 05 51 285 31 20	Laurel Point	43 08 16 105 33 43	9113.6 6349.6	9966.4 6943.7	5.66 3.95
Cypress Point	35 48 44.31	0 11 48.09	144 34 29 180 47 08	Second Creek	324 32 42 0 47 10	7863.2 8354.6	8599.0 9136.3	4.89 5.19
Frying Pan	35 45 00.98	0 08 39.38	180 42 56 176 20 02	Second Creek	0 43 00 356 19 54	13306.8 5710.1	14551.9 6244.4	8.27 3.55
Poplar Ridge	35 43 17.56	0 11 11.68	154 44 54 129 46 58	Lot Signal	334 43 17 309 45 29	9825.4 4982.4	10744.8 5448.6	6.10 3.10
G	35 46 57.99	0 12 13.29	56 09 26 110 02 47	Frying Pan	236 07 21 290 00 33	6473.0 6108.0	7078.7 6679.5	4.02 3.80
Stokes' Store, (west gable end.)	35 46 49.03	E. 0 12 16.94	58 40 10 112 07 23	Frying Pan	238 38 03 294 05 07	6401.6 6293.0	7000.6 6878.9	3.99 3.91

United States Coast Survey.—Geographical Positions. Section IV.—Alligator River. Sketch D.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance.		
						Metres.	Yards.	Miles.
H.....	35 45 20.33	E. 0 11 56.38	83 08 42 133 50 38	Frying Pan..... Lot Signal.....	263 06 47 313 48 34	4987.3 7367.4	5454.0 8056.8	3.10 4.58
U.....	35 45 52.33	0 08 21.98	224 17 43 318 11 26	Cypress Point..... Poplar Ridge.....	44 19 44 138 13 05	7408.2 6397.7	8101.4 6996.3	4.60 3.98
Q.....	35 42 12.18	0 08 52.72	176 16 59 240 00 18	Frying Pan..... Poplar Ridge.....	356 16 51 60 01 39	5213.4 4032.2	5701.2 4409.5	3.24 2.51
R.....	35 43 31.81	0 09 07.36	165 35 55 277 59 33	Frying Pan..... Poplar Ridge.....	345 35 39 98 00 46	2837.2 3155.0	3102.7 3450.2	1.76 1.96
S.....	35 42 28.19	0 08 29.96	182 51 24 249 43 47	Frying Pan..... Poplar Ridge.....	2 51 29 69 45 21	4693.3 4332.5	5132.5 4737.9	2.92 2.69
T.....	35 43 55.42	0 09 03.36	163 19 46 289 52 45	Frying Pan..... Poplar Ridge.....	343 19 32 109 54 00	2109.4 3429.3	2306.8 3750.2	1.31 2.13
Newport News	35 41 24.00	0 09 12.09	172 58 13 220 38 55	Frying Pan..... Poplar Ridge.....	352 57 54 40 40 05	6737.8 4613.6	7368.3 5045.3	4.19 2.87
J.....	35 42 18.91	0 11 17.12	61 42 28 141 33 20	Newport News..... Frying Pan.....	241 41 15 321 31 48	3569.9 6378.2	3903.9 6975.0	2.22 3.96
K.....	35 41 32.24	0 11 00.73	84 41 34 151 05 03	Newport News..... Frying Pan.....	264 40 31 331 03 40	2743.2 7350.1	2999.9 8037.9	1.70 4.57
I.....	35 43 55.08	0 11 36.03	37 51 28 114 35 15	Newport News..... Frying Pan.....	217 50 04 294 33 32	5896.7 4883.5	6448.5 5340.5	3.66 3.03
L.....	35 40 14.11	E. 0 10 29.73	137 48 59 190 33 31	Newport News..... Poplar Ridge.....	317 48 14 10 33 55	2907.2 5751.4	3179.2 6289.6	1.81 3.57

United States Coast Survey.—Geographical Positions. Section IV.—Croatan Sound. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Cove Signal	35 39 21.59	E. 0 10 02.56	161 24 14 193 25 46	Newport News Poplar Ridge	341 23 45 13 26 27	3980.4 7477.0	4352.9 8176.5	2.47 4.65
M	35 39 03.01	0 09 15.73	178 47 14 244 03 47	Newport News Cove Signal	358 47 12 64 04 14	4346.2 1309.7	4752.8 1432.3	2.70 0.81
O	35 39 35.58	0 08 43.70	208 31 23 282 15 01	Poplar Ridge Cove Signal	28 32 49 102 15 47	7787.4 2029.9	8512.8 2219.8	4.84 1.26
P	35 40 20.33	E. 0 08 56.01	211 58 03 317 14 02	Poplar Ridge Cove Signal	31 59 22 137 14 41	6439.4 2465.5	7041.9 2696.2	4.00 1.53
CROATAN SOUND.								
Midget	35 58 07.60	E. 0 21 24.20	247 45 39 298 47 54	Roden Carroon's Point	67 49 17 118 48 51	10056.8 2802.0	10997.8 3064.2	6.24 1.74
ROBERT'S FISHERY	35 56 06.08	0 24 26.03	138 44 18 212 12 42	Carroon's Point Roden	318 43 29 32 14 33	3185.7 8920.1	3483.7 9754.7	1.97 5.54
Robert's Fishery, (2)	35 56 06.67	0 24 27.17	138 08 40 212 06 59	Carroon's Point Roden	318 07 50 32 08 50	3191.4 8890.0	3490.0 9721.8	1.98 5.52
West End of Roanoke	35 56 06.26	0 27 40.23	108 56 47 179 10 24	Carroon's Point Roden	288 54 04 359 10 21	7366.5 7541.3	8055.7 8246.9	4.57 4.68
Dow	35 56 26.40	0 28 17.88	102 37 27 171 21 35	Carroon's Point Roden	282 34 22 251 21 11	8106.6 6999.2	8865.1 7654.1	5.03 4.34
Mann's Hill	35 56 10.19	E. 0 29 29.47	103 10 57 159 01 31	Carroon's Point Roden	283 07 14 339 00 24	9967.4 7946.2	10900.0 8689.7	6.19 4.93

United States Coast Survey.—Geographical Positions. Section IV.—Currituck Sound. Sketch D.

S. Doc. 3.

395

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Fleet Wood	35 52 59.29	E. 0 26 31.66	151 36 54 196 36 17	Robert's Fishery	331 35 41	6564.6	7178.8	4.07
				West End of Roanoke	16 36 58	6013.7	6576.4	3.73
Weir Point.....	35 55 31.93	0 27 59.60	25 07 03 101 22 43	Fleet Wood	205 06 12	5195.8	5681.9	3.22
				Robert's Fishery	281 20 40	5431.6	5939.8	3.37
Pork Point	35 52 59.44	0 30 28.51	89 58 13 141 32 38	Fleet Wood	269 55 54	5940.6	6496.5	3.69
				Weir Point.....	321 31 11	6002.5	6564.2	3.72
Red Stone.....	35 54 35.14	0 25 32.24	244 37 56 149 57 32	Weir Point.....	64 39 22	4088.1	4470.6	2.54
				Robert's Fishery.....	329 56 54	3258.4	3563.3	2.02
Callaghan's Creek.....	35 50 47.78	0 26 58.21	170 39 51 232 24 47	Fleet Wood	350 39 35	4107.5	4491.8	2.55
				Pork Point.....	52 26 50	6655.7	7278.4	4.13
Baum's Creek.....	35 50 41.93	E. 0 31 26.86	160 56 37 119 46 26	Pork Point.....	340 56 03	4484.0	4903.5	2.78
				Fleet Wood	299 43 33	8530.7	9328.9	5.30
CURRITUCK SOUND.								
SHELL BANK.....	36 03 20.93	E. 0 26 57.96	.....	.....	.....	.....	.....	.....
POWELL'S POINT	36 04 18.83	0 23 26.73	.....	.....	.....	.....	.....	.....
Kill Devil Hill.....	36 01 07.05	0 31 17.91	122 24 03 116 39 32	Shell Bank	302 21 30	7702.5	8423.2	4.79
				Powell's Point	296 34 55	13190.5	14424.7	8.20
Sampson's Point	36 04 49.08	0 23 58.90	357 35 04 301 12 57	Robert's Fishery.....	177 35 20	16132.3	17641.8	10.02
				Shell Bank	121 14 43	5239.2	5729.4	3.26
Paul Gamiel's Hill.....	36 09 16.29	E. 0 26 39.91	27 48 19 26 03 55	Powell's Point	207 46 25	10361.6	11331.3	6.44
				Sampson's Point	206 02 20	9166.6	10024.3	5.70

United States Coast Survey.—Geographical Positions. Section IV.—Roanoke Island and Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Martin's Point.....	36 07 31.62	E. 0 26 16.20	35 31 09	Powell's Point.....	215 29 30	7297.8	7980.7	4.53
			34 26 17	Sampson's Point.....	214 24 56	6073.1	6641.4	3.77
Pig Point.....	36 06 48.26	0 23 33.68	251 47 04	Martin's Point.....	71 48 40	4277.5	4677.7	2.66
			321 19 58	Shell Bank.....	141 21 58	8181.5	8947.1	5.08
Thoroughfare Island.....	36 09 38.31	0 22 33.54	305 02 03	Martin's Point.....	125 04 14	6798.5	7434.6	4.22
			276 16 04	Paul Gamiel's Hill.....	96 18 30	6194.4	6774.0	3.85
North Banks.....	36 11 52.05	0 25 44.93	354 26 17	Martin's Point.....	174 26 35	8064.1	8818.7	5.01
			344 01 24	Paul Gamiel's Hill.....	164 01 57	4992.9	5460.1	3.10
Hog Quarter Windmill.....	36 07 19.34	0 22 50.33	174 24 20	Thoroughfare Island.....	354 24 10	4303.2	4705.9	2.67
			265 46 34	Martin's Point.....	85 48 35	5161.0	5643.9	3.21
Poke Point.....	36 13 07.44	0 20 19.28	285 54 55	North Banks.....	105 58 07	8458.6	9250.1	5.26
			332 29 46	Thoroughfare Island.....	152 31 05	7265.4	7945.2	4.51
Jew's Quarter.....	36 11 22.51	E. 0 21 36.20	261 38 30	North Banks.....	81 40 57	6279.6	6867.2	3.90
			335 57 03	Thoroughfare Island.....	155 57 36	3516.1	3845.1	2.19
ROANOKE ISLAND AND BODIE'S ISLAND.								
NORTH END OF BASE.....	35 53 56.56	E. 0 35 32.90						
SOUTH END OF BASE.....	35 48 34.03	0 38 25 45	156 28 48	North End of Base.....	336 27 07	10841.5	11855.9	6.735
Shallow Back Bay.....	35 55 08.19	E. 0 31 52.78	172 48 05	Mann's Point.....	352 47 48	5784.8	6326.0	3.59
			291 47 18	North End of Base.....	111 49 28	5944.5	6500.7	3.69

United States Coast Survey.—Geographical Positions. Section IV.—Roanoke Island and Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Meekin's Mill.....	35 51 28.60	E. 0 33 10.23	218 07 14 304 11 49	North End of Base..... South End of Base.....	38 08 38 124 14 54	5795.8 9567.3	6338.1 10462.5	3.60 5.94
Roanoke Island, south end....	35 49 58.25	0 34 20.14	193 57 26 292 50 40	North End of Base..... South End of Base.....	13 58 09 112 53 04	7566.7 6682.7	8274.7 7308.2	4.70 4.15
Jacock	35 56 35.47	0 33 58.59	275 13 21 88 08 58	Carroon's Point..... Dow.....	275 06 57 268 05 38	16516.9 8543.7	18062.3 9343.1	10.26 5.30
Sugar Wreck.....	35 54 38.86	0 35 41.05	8 54 40 63 10 38	North End of Base..... No. 4.....	188 54 35 243 09 39	1319.3 2816.6	1442.7 3080.1	0.81 1.74
Nag's Head.....	35 55 43.68	0 34 44.19	324 29 02 339 41 35	Sugar Wreck..... North End of Base.....	144 29 35 159 42 03	2454.0 2519.6	2683.6 3848.9	1.52 2.18
First Mile Stone.....	35 53 08.73	0 35 58.52	156 27 22	North End of Base.....	336 27 07	1608.0	1758.4	1.00
Second Mile Stone	35 52 20.90	0 36 24.13	156 27 37	First Mile Stone.....	336 27 22	1608.0	1758.4	1.00
Beach Signal.....	35 53 41.79	0 36 14.52	113 34 32 354 28 53	North End of Base..... Second Mile Stone.....	293 34 08 174 28 54	1138.7 2504.6	1245.2 2738.9	0.70 1.55
Tent Pole.....	35 51 51.34	0 36 57.71	148 06 16 137 14 39	First Mile Stone	328 05 41	2809.4	3072.2	1.74
Third Mile Stone.....	35 51 33.06	0 36 49.73	156 27 52 199 34 23	Second Mile Stone..... Tent Pole	317 14 19	1240.8	1356.8	0.77
No. 1.	35 51 02.44	E. 0 36 11.52	187 26 50 225 26 07	Second Mile Stone..... Third Mile Stone.....	336 27 37 19 34 28	1608.0 597.8	1758.4 653.7	1.00 0.37
					7 26 57 45 26 30	2438.6 1345.1	2666.7 1470.9	1.51 0.84

United States Coast Survey.—Geographical Positions. Section IV.—Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
No. 2.....	35 51 51.90	E. 0 35 37.48	232 37 39 287 45 20	Second Mile Stone..... Third Mile Stone.....	52 38 06 107 46 02	1472.2 1903.1	1609.9 2081.1	0.91 1.18
No. 3.....	35 52 58.36	0 34 51.30	210 10 58 259 15 49	North End of Base..... First Mile Stone.....	30 11 22 79 16 28	2075.0 1716.0	2269.1 1876.5	1.28 1.06
No. 4.....	35 53 57.61	0 34 00.80	270 47 15 297 01 23	North End of Base..... First Mile Stone.....	90 48 09 117 02 32	2309.4 3313.9	2525.4 3623.9	1.44 2.06
Fourth Mile Stone.....	35 50 45.23	0 37 15.32	156 28 07	Third Mile Stone.....	336 27 52	1608.0	1758.4	1.00
Fifth Mile Stone.....	35 49 57.40	0 37 40.90	156 28 22	Fourth Mile Stone.....	336 28 07	1608.0	1758.4	1.00
Sixth Mile Stone.....	35 49 09.55	0 38 06.47	336 28 37 156 28 37	South End of Base..... Fifth Mile Stone.....	156 28 48 336 28 22	1194.1 1608.0	1305.8 1758.4	0.74 1.00
Tommy's Hammock.....	35 50 47.54	0 36 50.73	324 50 04 178 58 31	Fifth Mile Stone..... Third Mile Stone.....	140 50 33 358 58 30	1993.5 1403.1	2180.0 1534.3	1.23 0.87
Four Wrecks Signal.....	35 51 04.74	0 37 33.65	128 23 38 354 59 23	Third Mile Stone..... Fifth Mile Stone.....	308 23 12 177 59 27	1405.9 2083.5	1537.4 2278.4	0.87 1.29
Barrel Head.....	35 49 55.46	0 38 11.41	137 27 39 5 00 19	Fourth Mile Stone..... Fifth Mile Stone.....	317 27 06 185 00 16	2081.7 768.0	2276.4 839.8	1.29 0.49
Cedar Point.....	35 49 06.28	0 37 04.62	210 01 48 266 16 55	Fifth Mile Stone..... Sixth Mile Stone.....	30 02 09 86 17 31	1819.4 1555.8	1989.6 1701.3	1.12 0.97
Cut-off Point.....	35 48 25.52	E. 0 37 18.91	261 05 02 164 03 42	South End of Base..... Cedar Point.....	81 05 41 344 03 26	1690.9 1306.2	1849.1 1428.4	1.05 0.81

United States Coast Survey.—Geographical Positions. Section IV.—Bodie's Island. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Howard Signal.....	35 49 11.88	E. 0 38 36.38	53 42 18 84 32 02	Cut-off Point..... Sixth Mile Stone	233 41 33 264 31 45	2412.9 754.1	2638.6 824.6	1.49 0.46
North Duck Island	35 48 17.10	0 35 30.94	237 11 22 264 31 13	Cedar Point..... Cut-off Point	57 12 17 84 32 16	2797.4 2722.7	3059.1 2977.4	1.73 1.69
South Duck Island	35 47 40.09	0 36 04.93	209 25 18 232 58 52	Cedar Point..... Cut-off Point	29 25 53 52 59 35	3049.4 2325.7	3334.7 2543.3	1.89 1.44
North Point	35 48 13.57	0 39 09.50	97 34 08 19 41 32	Cut-off Point	277 33 03	2800.6	3062.6	1.73
				South end of Base.....	299 41 06	1272.6	1391.6	0.79
Bodie's Island Light-house..	35 47 20.54	0 39 23.79	160 52 27 147 06 54	Howard Signal..... South end of Base.....	340 51 59 327 06 20	3631.6 2696.7	3971.4 2949.0	2.25 1.67
Midget.....	35 47 32.93	0 39 40.80	92 20 49 134 52 15	South Duck Island	272 18 43	5424.5	5932.0	3.37
				South End of Base	314 51 30	2668.8	2918.5	1.65
Green Island	35 45 57.80	0 39 13.61	165 54 18 193 06 36	South End of Base	345 53 50	4963.8	5428.2	3.08
				Midget	13 06 52	3010.2	3291.8	1.89
Wreck Safford.....	35 45 39.33	0 40 56.23	102 27 36 151 35 26	Green Island	282 26 36	2639.5	2886.5	1.64
				Midget.....	331 34 41	3980.3	4352.7	2.47
Salt Pump	35 46 48.84	0 39 49.31	321 52 28 29 41 12	Wreck Safford.....	141 53 07	2722.6	2977.4	1.69
				Green Island	209 40 51	1810.3	1979.7	1.12
Eagle Nest Point.....	35 44 10.55	0 40 17.58	154 04 36 119 32 03	Green Island	334 03 59	3675.1	4019.0	2.28
				Wreck Safford.....	19 32 26	2903.2	3174.9	1.80
Gar Island	35 45 10.52	E. 0 39 54.48	144 50 33 342 33 39	Green Island	324 50 09	1782.4	1949.2	1.11
				Eagle Nest Point.....	162 33 53	1936.9	2118.1	1.20

United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.		Longitude.		Azimuth.		To station—	Back azimuth.	Distance.		Distance.
	°	'	°	'	°	'			Metres.	Yards.		Miles.
Ethridge's House	35	44 32.61	E. 0 41 16.09	65 10 53 166 21 46	Eagle Nest Point	245 10 19 346 21 34	1619.6 2115.8	1771.2 2313.8	1.01 1.31		
Brig Adams	35	43 56.40	0 41 44.80	101 15 43 158 57 44	Eagle Nest Point	281 14 51 338 57 16	2234.6 3398.8	2443.7 3716.8	1.39 2.11		
Pea Island	35	42 37.44	0 40 41.37	168 13 56 213 13 29	Eagle Nest Point	348 13 42 33 14 06	2931.0 2908.9	3205.3 3181.1	1.82 1.81		
Little Pea Island.....	35	43 14.21	0 40 33.68	166 53 03 233 57 29	Eagle Nest Point	346 52 54 53 58 11	1782.8 2210.1	1949.6 2416.9	1.11 1.37		
Pea Island Main	35	43 06.35	0 41 20.61	201 30 48 47 54 37	Brig Adams	21 31 02 47 54 14	1657.8 1329.0	1812.9 1453.4	1.03 0.83		
New Inlet, North Point	35	42 00.54	0 42 20.40	114 33 47 165 56 07	Pea Island.....	294 22 49 345 55 46	2736.7 3680.9	2992.8 4025.3	1.70 2.29		
Jack Shoal	35	41 08.97	0 41 14 02	163 14 59 226 23 57	Pea Island.....	343 14 40 46 24 36	2847.1 2304.4	3113.5 2520.0	1.77 1.43		
New Inlet, South Point	35	41 03.90	E. 0 42 35.62	124 49 48 168 39 02	Jack Shoal	304 48 54 348 38 47	2057.6 1786.9	2250.1 1954.1	1.28 1.11		
FROM NEW INLET TO CAPE HATTERAS.											
South of New Inlet Signal...	35	40 16.81	E. 0 42 45 93	94 22 01 167 38 20	Jack Shoal	274 21 13 347 38 11	2815.1 3260.3	3078.5 3565.4	1.75 2.03		
Loggerhead Inlet	35	38 14.74	E. 0 42 47.23	155 58 28 178 44 16	Jack Shoal	335 57 33 358 44 14	5879.0 3762.7	6429.1 4114.8	3.65 2.34		

United States Coast Survey,—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Loggerhead Shoal.....	35 37 59.39	E. 0 42 13.63	242 09 20 190 51 04	Loggerhead Inlet..... South of New Inlet.....	62 09 41 10 51 23	1012.5 4312.1	1107.3 4715.6	0.63 2.68
Chickamicomico North.....	35 36 11.26	0 43 43.43	145 52 08 160 17 08	Loggerhead Shoal..... Loggerhead Inlet.....	325 51 16 340 16 37	4025.7 4041.8	4402.4 4420.0	2.50 2.51
Wind Mill.....	35 35 52.54	0 43 03.52	175 18 36 240 07 11	Loggerhead Inlet..... Chickamicomico North.....	355 18 28 60 07 35	4396.8 1158.4	4808.2 1266.7	2.73 0.71
Chickamicomico Main.....	35 34 46.74	0 43 19.81	192 51 17 168 33 54	Chickamicomico North..... Windmill.....	12 51 30 348 33 45	2671.6 2068.7	2921.5 2262.2	1.65 1.28
Chickamicomico, (2).....	35 35 08.02	0 43 49.73	139 42 45 48 57 31	Windmill..... Chickamicomico Main.....	319 42 18 228 57 14	1798.7 998.5	1967.0 1091.9	1.11 0.62
Chickamicomico, (3).....	35 34 17.60	0 43 46.98	142 42 29 182 32 45	Chickamicomico Main..... Chickamicomico, (2).....	322 42 13 2 32 46	1129.0 1555.3	1234.9 1700.8	0.73 0.96
Chickamicomico, (4).....	35 32 44.97	0 43 33.14	174 53 24 186 57 36	Chickamicomico Main..... Chickamicomico, (3).....	354 53 16 6 57 45	3767.7 2875.8	4120.5 3144.8	2.34 1.78
Opening Marsh.....	35 33 05.64	0 42 54.39	210 50 19 303 08 02	Chickamicomico, (3)..... Chickamicomico, (4).....	30 50 50 123 08 24	2582.9 1165.4	2824.5 1274.4	1.60 0.72
Wreck Dolphin.....	35 31 20.21	0 43 05.94	174 53 07 194 41 49	Opening Marsh..... Chickamicomico, (4).....	354 53 03 14 42 05	3261.9 2700.2	3567.1 2952.8	2.03 1.67
No Egg Point.....	35 31 47.58	0 42 21.57	225 08 29 307 39 08	Chickamicomico, (4)..... Wreck Dolphin.....	45 09 10 127 39 33	2507.1 1380.0	2741.6 1509.3	1.55 0.85
Cedar Hammock Island.....	35 30 37.81	E. 0 42 01.55	193 50 08 231 08 42	No Egg Point..... Wreck Dolphin.....	13 50 20 51 09 20	2213.9 2082.9	2421.0 2277.8	1.38 1.29

Name of station.	Latitude.		Longitude.		Azimuth.	To station—	Back azimuth.	Distance.		Distance.
	° ' "	° ' "	° ' "	° ' "				Metres.	Yards.		Miles.
Bay Signal	35 29 49.51	E. 0 42 47.88	141 53 58 189 14 43			Cedar Hammock Island..... Wreck Dolphin.....	321 53 31 9 14 54	1891.7 2831.9	2063.7 3096.8	1.17 1.76
Myrtle Signal.....	35 28 16.91	0 42 33.91	169 22 00 92 55 53			Cedar Hammock Island..... Gull Island.....	349 21 41 272 54 15	4418.0 4271.0	4831.4 4670.6	2.74 2.65
Gull Island.....	35 28 23.97	0 39 44.70	240 15 37 219 53 27			Bay Signal	60 17 24	5316.4	5813.8	3.30
Little Hill.....	35 26 20.03	0 42 26.13	183 06 57 133 11 26			Cedar Hammock Island.....	39 54 47	5376.6	5879.6	3.34
Drain Island.....	35 25 56.75	0 41 48.79	194 45 09 232 41 47			Myrtle Signal.....	3 07 02	3607.1	3944.6	2.24
Bald Beach.....	35 25 18.87	0 42 23.38	143 13 40 182 06 30			Gull Island.....	313 09 53	5581.5	6103.7	3.46
Terrapin Point.....	35 24 46.15	0 41 44.00	183 10 43 224 34 31			Myrtle Signal.....	14 45 36	4466.6	4884.5	2.78
Barnes' Signal.....	35 24 27.03	0 42 18.27	124 16 45 184 36 34			Little Hill.....	52 52 09	1184.0	1294.7	0.73
Bog Channel	35 23 56.28	0 41 32.14	191 00 49 230 50 53			Drain Island.....	323 13 19	1457.3	1593.6	0.90
Bog Opening	35 23 17.38	0 41 58.15	151 18 26 193 18 33			Little Hill.....	2 06 32	1886.0	2062.4	1.17
Old Tree.....	35 22 43.74	E. 0 41 27.23	183 10 24 216 57 47			Drain Island.....	3 10 45	2178.8	2382.6	1.35
						Bald Beach.....	44 34 54	1415.3	1547.7	0.87
						Terrapin Point.....	304 16 25	1046.4	1144.3	0.65
						Bald Beach.....	4 36 37	1602.6	1752.6	0.99
						Terrapin Point.....	11 00 56	1565.7	1712.2	0.97
						Barnes' Signal	50 51 19	1500.8	1641.2	0.93
						Bog Channel.....	331 18 11	1366.7	1494.6	0.85
						Barnes' Signal	13 18 45	2205.6	2412.0	1.37
						Bog Channel.....	3 10 27	2239.0	2448.5	1.39
						Bog Opening.....	36 58 05	1297.5	1418.9	0.81

United States Coast Survey.—Geographical Positions. Section IV.—New Inlet to Cape Hatteras. Sketch D.

S. Doc. 3.

403

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Stowe	35 22 27.74	E. 0 41 46.61	135 13 12 190 46 29	Old Tree..... Bog Opening.....	315 13 00 10 46 36	694.5 1557.1	759.5 1702.8	0.43 0.97
Mill Creek	35 22 04.06	0 41 06.74	202 55 11 234 02 31	Old Tree..... Stowe	22 55 23 54 02 54	1327.7 1243.2	1451.9 1359.5	0.82 0.77
Scarborough.....	35 21 16.89	0 41 18.78	168 11 21 197 49 52	Mill Creek	348 11 14 17 50 08	1484.9 2293.7	1623.8 2508.3	0.93 1.42
Lookout, (1)	35 21 08.66	0 40 32.70	206 43 15 257 42 39	Mill Creek	26 43 34 77 43 05	1911.1 1190.6	2089.9 1302.0	1.19 0.74
Lookout, (2)	35 20 38.25	0 40 59.79	143 52 46 201 55 59	Lookout, (1)..... Scarborough.....	323 52 30 21 56 10	1160.3 1283.5	1263.9 1403.6	0.72 0.80
Barnes' Mill.....	35 20 04.26	0 40 18.95	189 55 16 224 32 54	Lookout, (1)..... Lookout, (2).....	9 55 24 44 33 17	2015.0 1470.0	2203.6 1607.6	1.25 0.91
Lookout, (3)	35 20 06.93	0 40 58.26	85 15 00 182 18 24	Barnes' Mill..... Lookout, (2).....	265 14 37 2 18 25	995.9 965.9	1089.1 1056.3	0.62 0.60
Long Point.....	35 18 38.77	0 40 21.37	178 40 11 198 55 22	Barnes' Mill..... Lookout, (3).....	358 40 10 18 55 43	2634.9 2872.0	2881.4 3140.7	1.64 1.78
Jardella	35 18 12.28	0 40 56.11	164 47 01 132 55 35	Barnes' Mill..... Long Point	344 46 40 312 55 15	3575.9 1198.7	3910.5 1310.9	2.22 0.74
Log	35 16 54.71	0 40 50.87	166 54 55 183 10 12	Long Point..... Jardella.....	346 54 37 3 10 15	3292.0 2393.9	3600.0 2617.9	2.05 1.49
Palmetto.....	35 16 10.34	E. 0 39 44.97	191 21 57 230 36 39	Long Point..... Log	11 22 17 50 37 18	4665.4 2154.8	5101.9 2356.4	2.90 1.34

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Yards.	Metres.	Miles.
Last Signal.....	35 15 51.12	E. 0 40 45.39	111 12 13 184 02 38	Palmetto.....	291 11 38	1791.2	1637.9	1.02
				Log	4 02 41	2148.2	1964.4	1.22
CAPE HATTERAS TO OCRACOKE INLET.								
Cape Hatteras Light-house..	35 15 11.08	E. 0 40 09.36	161 20 37 216 25 23	Palmetto.....	341 20 23	2107.8	1927.5	1.19
				Last Signal.....	36 25 44	1676.9	1533.5	0.95
A	35 14 45.00	0 40 34.99	141 07 43 187 20 58	Light-house	321 07 28	1128.7	1032.2	0.64
				Last Signal.....	7 21 10	2246.6	2054.4	1.27
Cove Point.....	35 13 39.59	0 39 51.86	208 24 24 188 55 07	A.....	28 23 58	2516.7	2292.3	1.42
				Light-house	8 55 17	3130.9	2853.9	1.77
King's Point	35 16 11.73	0 35 16.56	284 08 57 226 48 24	Light-house.....	104 11 47	8347.1	7632.9	4.74
				Barnes' Mill	46 51 18	11452.9	10473.0	6.51
Jannet's Mill	36 16 16.60	0 38 52.95	88 26 51 197 11 46	King's Point.....	268 24 46	5982.4	5470.5	3.40
				Barnes' Mill	17 12 35	8030.9	7343.8	4.56
Bare Hill	35 13 25.51	0 32 37.86	218 03 17 254 03 23	King's Point.....	38 04 48	12979.6	11869.0	7.38
				Light-house.....	74 07 44	7115.1	6506.3	4.04
Egg Shoal.....	35 15 29.56	0 28 28.09	301 10 08 262 47 33	Bare Hill.....	121 12 32	8071.9	7381.3	4.59
				King's Point.....	82 51 29	11378.3	10404.7	6.47
Duran's Point.....	35 14 02.74	0 30 35.35	290 18 18 129 45 18	Bare Hill	110 19 57	3612.2	3303.1	2.05
				Egg Shoal.....	309 44 06	4575.6	4184.1	2.60
Porpoise	35 12 25.60	E. 0 30 11.90	155 09 46 227 50 17	Egg Shoal	335 08 47	6831.6	6247.0	3.88
				King's Point.....	47 53 12	11358.2	10386.3	6.45

United States Coast Survey.—Geographical Positions. Section IV.—Cape Hatteras to Ocracoke Inlet. Sketch D.

S. Doc. 3.

405

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
East Inlet.....	35 11 52.80	E. 0 27 50.75	188 02 30 254 10 50	Egg Shoal..... Porpoise	8 02 51 74 12 11	6746.0 3710.4	7377.2 4057.6	4.19 2.31
West Inlet	35 11 08.59	0 26 22.63	201 31 04 247 43 42	Egg Shoal..... Porpoise	21 32 16 67 45 54	8644.8 6265.9	9453.7 6852.2	5.37 3.89
Legged Lump	35 12 17.87	0 21 33 90	286 16 16 240 32 28	West Inlet	106 19 03	7609.0	8321.4	4.73
				Egg Shoal.....	60 36 27	12023.0	13148.0	7.47
Wells' Creek	35 10 07.25	0 23 15.55	147 26 07 248 12 50	Legged Lump	327 25 09	4776.5	5223.4	2.97
				West Inlet	68 14 37	5096.7	5573.6	3.17
Clark's Reef.....	35 09 45.77	0 18 07.34	265 07 32 228 05 35	Wells' Creek	85 10 29	7826.8	8559.1	4.86
				Legged Lump.....	48 07 36	7019.4	7676.2	4.36
Great Swash.....	35 08 52.96	0 19 01.68	139 48 07 250 22 10	Clark's Reef.....	319 47 35	2130.3	2329.7	1.32
				Wells' Creek	70 24 37	6820.0	7458.2	4.24
1st Hammock Hill	35 07 14.52	0 15 10.88	242 32 28 223 46 00	Great Swash.....	62 34 43	6583.0	7199.0	4.09
				Clark's Reef.....	43 47 40	6455.3	7059.3	4.01
Our Reef.....	35 08 39.32	0 12 53.77	306 57 59 255 30 26	1st Hammock Hill	126 59 17	4344.6	4751.1	2.70
				Clark's Reef.....	75 33 27	8195.6	8962.4	5.09
Ocracoke Light-house	35 06 31.63	0 12 16.08	253 21 40 193 37 36	1st Hammock Hill	73 23 21	4618.8	5050.9	2.87
				Our Reef.....	13 37 58	4048.7	4427.5	2.52
Middle Ground.....	35 05 33.61	0 11 01.48	206 24 29 243 45 56	Our Reef.....	26 25 34	6389.9	6987.8	3.97
				1st Hammock Hill	63 48 19	7039.1	7697.8	4.37
Beacon Island	35 06 02.87	E. 0 08 38.48	233 58 09 233 15 37	Middle Ground.....	103 59 31	3732.2	4081.4	2.32
				Our Reef.....	53 18 04	8063.2	8817.7	5.01

United States Coast Survey.—Geographical Positions. Section IV.—Cape Hatteras to Ocracoke Inlet. Sketch D.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
			° ' "		° ' "	Metres.	Yards.	Miles.
East Portsmouth.....	35 03 55.31	E. 0 08 38.73	179 54 20 230 02 17	Beacon Island	359 54 20	3930.5	4298.3	2.44
				Middle Ground.....	50 03 39	4716.9	5158.2	2.93
Shell Island	35 06 10.71	0 06 36.01	323 18 06 274 26 41	East Portsmouth	143 19 17	5202.8	5689.7	3.23
				Beacon Island	94 27 52	3110.7	3401.8	1.93
Portsmouth Castle	35 05 50.54	0 07 06.23	326 34 18 260 45 20	East Portsmouth	146 35 11	4254.0	4652.1	2.64
				Beacon Island	80 46 13	2366.8	2588.2	1.47
Portsmouth Steeple	35 04 09.34	E. 0 07 45.40	154 50 10 201 01 05	Shell Island	334 49 30	4132.4	4519.1	2.57
				Beacon Island	21 01 35	3747.9	4098.6	2.33

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
CHARLESTON HARBOR.	° ' "	° ' "	° ' "		° ' "			
Breach Inlet.....	32 46 19.27	79 48 43.02	273 45 29	Breach Inlet.....	93 49 14	10842.1	11856.6	6.74
Circular Church.....	32 46 42.53	79 55 38.77	225 00 29	Breach Inlet.....	45 02 09	6831.2	7470.4	4.25
Vincent.....	32 43 42.51	79 51 48.67	132 48 50	Circular Church.....	312 46 46	8161.9	8925.6	5.07
Mount Pleasant.....	32 47 13.39	79 52 37.61	348 54 06	Vincent.....	168 54 33	6619.3	7238.7	4.11
Fort Johnson.....	32 45 09.48	79 53 34.77	78 36 50	Circular Church.....	258 35 12	4808.4	5258.3	2.99
Castle Pinckney.....	32 46 23.92	79 54 25.07	314 07 02	Vincent.....	134 07 59	3847.7	4207.7	2.39
Styles.....	32 45 10.70	79 55 34.41	131 37 30	Circular Church.....	311 36 23	4316.3	4720.2	2.68
Hobcaw.....	32 48 47.23	79 54 11.55	270 53 48	Breach Inlet.....	90 56 53	8902.2	9735.2	5.53
North Base.....	32 48 48.83	79 56 51.32	241 24 12	Mount Pleasant.....	61 25 10	3184.3	3482.3	1.98
South Base.....	32 47 46.38	79 56 14.84	177 42 19	Circular Church.....	357 42 17	2830.9	3095.8	1.76
Crafts.....	32 47 10.29	79 58 07.14	218 39 42	Castle Pinckney.....	38 40 20	2888.4	3158.7	1.80
			30 34 43	Circular Church.....	210 33 56	4461.1	4878.5	2.77
			4 33 33	Castle Pinckney.....	184 33 25	4428.3	4842.7	2.75
			334 06 35	Circular Church.....	154 07 15	4324.0	4728.6	2.69
			270 40 00	Hobcaw.....	90 41 27	4156.2	4545.1	2.58
			334 28 33	Circular Church.....	154 28 53	2179.0	2372.9	1.36
			153 44 55	North Base.....	333 44 36	2145.0	2345.7	1.33
			213 00 51	North Base.....	33 01 32	3619.8	3958.5	2.25
			312 48 38	Styles.....	132 50 00	5419.2	5926.3	3.37

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude. O ' "	Longitude. O ' "	Azimuth. O ' "	To station—	Back azimuth. O ' "	Distance.		
						Metres.	Yards.	Miles.
Arsenal	32 47 07.61	79 56 41.62	295 16 22 210 14 59	Circular Church	115 16 56	1808.6	1977.8	1.12
				South Base	30 15 14	1382.4	1511.8	0.86
Fort Moultrie	32 45 31.14	79 51 14.90	79 37 33 14 43 21	Fort Johnson	259 36 17	3700.9	4047.2	2.30
				Vincent	194 43 03	3459.4	3783.0	2.15
Charleston Light	32 41 54.77	79 52 28.84	150 51 45 159 57 30	Circular Church	330 50 02	10149.6	11099.3	6.31
				Castle Pinckney	339 56 27	8825.3	9651.1	5.48
Beacon, (back of Sullivan's Island.)	32 46 50.54	79 51 15.87	8 23 22 80 33 25	Vincent	188 23 04	5854.7	6402.5	3.64
				Castle Pinckney	260 31 43	4990.7	5457.7	3.10
Beacon, (south of Fort Moultrie.)	32 45 29.40	79 51 10.95	80 41 58 16 36 41	Fort Johnson	260 40 40	3793.0	4147.9	2.36
				Vincent	196 36 21	3435.6	3757.1	2.13
Pinckney House, (on Sullivan's Island.)	32 45 47.52	79 49 59.19	36 30 47 243 43 03	Vincent	216 29 48	4790.1	5238.3	2.98
				Breach Inlet	63 43 44	2210.2	2417.0	1.37
Fort Sumpter	32 45 07.95	79 52 14.52	171 09 41 91 17 35	Mount Pleasant	351 09 28	3910.6	4276.5	2.43
				Fort Johnson	271 16 52	2089.5	2285.0	1.30
St. Michael's Church	32 46 33.11	79 55 37.60	308 51 17 278 31 04	Fort Johnson	128 52 23	4105.5	4489.7	2.55
				Castle Pinckney	98 31 43	1908.5	2807.1	1.19
Oyster Point	32 49 40.07	79 55 13.31	24 34 01 6 54 17	South Base	204 33 28	3850.4	4210.7	2.39
				Circular Church	186 54 03	5508.4	6023.8	3.42
White House	32 49 39.29	79 56 08.06	297 52 27 269 01 33	Hobcaw	117 53 30	3428.4	3749.2	2.13
				Oyster Point	89 02 03	1424.0	1557.2	0.89
Belvidere Mill	32 49 07.69	79 56 10.06	2 50 05 349 40 51	South Base	182 50 02	2507.8	2742.5	1.56
				Circular Church	169 41 08	4544.5	4969.7	2.82

United States Coast Survey.—Geographical Positions. Section V.—Charleston Harbor. Sketch E.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Wappoo	32 46 10.11	79 57 24.64	250 03 39 212 17 11	Circular Church	70 04 36	2931.0	3205.3	1.82
				Arsenal	32 17 34	2094.5	2290.5	1.30
Cotton Factory	32 47 45.03	79 55 52.45	317 42 01 196 01 43	Castle Pinckney	137 42 48	3377.8	3693.9	2.10
				Oyster Point	16 02 04	3687.3	4032.3	2.29
Flynn's Church	32 47 18.07	79 55 49.33	222 47 55 354 20 44	Hobcaw	42 48 48	3743.6	4093.9	2.33
				Styles	174 20 52	3942.3	4311.2	2.45
Hog Island Beacon	32 46 55.54	79 54 41.85	22 57 31 335 51 04	Styles	202 57 03	3506.8	2834.9	2.18
				Castle Pinckney	155 51 13	1067.1	1066.9	0.66
Grave Church	32 46 52.01	79 55 58.56	348 36 37 218 06 03	Styles	168 36 50	3183.0	3480.8	1.98
				Hobcaw	38 07 01	4510.8	4942.9	2.80
Orphans' Asylum	32 47 08.68	79 56 02.25	348 43 26 268 25 36	Styles	168 43 41	3705.5	4052.2	2.30
				Mount Pleasant	88 27 27	5326.6	5825.0	3.31
Gibbes' Observatory, Charles- ton.	32 47 05.33	79 55 59.81	148 17 40	Orphan Asylum	328 17 40	121.0	132.3	0.08
SAVANNAH, GA.								
Savannah Exchange Spire...	32 04 53.36	81 05 14.32						

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
FLORIDA KEYS.								
Key West to Marquesas.								
Sand Key	24 27 09.51	0 00 00.00						
West Crawfish Key	24 32 16.16	W. 0 00 22.71	356 07 21	Sand Key	176 07 30	9455.6	10340.4	5.88
Tift's Observatory	24 33 31.13	E. 0 04 12.27	31 10 55 73 25 01	Sand Key	211 09 11	13721.1	15005.0	8.53
				West Crawfish Key	253 23 07	8074.3	8829.8	5.02
East Crawfish Key	24 33 39.95	0 00 58.10	272 49 58 7 45 24	Tift's Observatory	92 51 18	5470.2	5982.1	3.40
				Sand Key	187 45 00	12150.7	13287.7	7.55
N. W. Boca Chica	24 38 24.62	0 05 53.51	17 30 37 43 30 40	Tift's Observatory	197 29 54	9467.9	10353.8	5.88
				East Crawfish Key	223 28 37	12072.7	13202.4	7.50
East Point	24 34 13.72	0 06 57.32	74 15 12 166 54 50	Tift's Observatory	254 14 04	4825.3	5276.8	3.00
				N. W. Boca Chica	346 54 23	7925.2	8666.8	4.92
Fleming's Key	24 34 40.07	0 04 45.57	195 27 25 23 50 10	N. W. Boca Chica	15 27 54	7168.0	7838.7	4.45
				Tift's Observatory	203 49 56	2318.7	2535.7	1.44
U. S. Barracks	24 33 37.93	0 05 04.77	250 49 12 81 56 24	East Point	70 49 59	3352.9	3666.6	2.08
				Tift's Observatory	261 56 03	1491.8	1631.4	0.93
Key West Light	24 32 58.10	0 04 35.87	81 17 13 239 41 01	West Crawfish Key	261 15 09	8500.6	9296.0	5.28
				East Point	59 42 00	4610.3	5041.7	2.86
Old Beacon	24 32 38 01	E. 0 04 23.59	85 14 46 168 57 58	West Crawfish Key	265 12 47	8085.0	8841.5	5.03
				Tift's Observatory	348 57 53	1665.0	1820.8	1.04

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Rocky Point.....	24 33 03.26	E. 0 07 19.22	99 16 01 166 18 02	Tift's Observatory..... N. W. Boca Chica.....	279 14 43 346 17 26	5329.9 10176.5	5828.6 11128.7	3.30 6.32
Western Sambo.....	24 28 47.10	0 09 34.60	133 56 34 79 31 13	Tift's Observatory..... Sand Key.....	313 54 20 259 27 15	12596.2 16456.0	13774.9 17995.8	7.83 10.22
Wreck of the Frankford....	24 34 58.16	0 03 37.47	53 36 15 211 03 21	N. Crawfish Key..... N. W. Boca Chica.....	233 34 35 31 04 19	8397.1 7415.2	9182.8 8109.1	5.22 4.61
Bank in N. W. Channel.....	24 35 00 27	E. 0 03 05.52	216 54 54 49 15 30	N. W. Boca Chica..... W. Crawfish Key.....	36 56 04 229 14 04	7864.6 7734.3	8600.5 8458.0	4.89 4.81
Cottrel's Key.....	24 36 01.19	W. 0 02 38.04	331 10 55 252 55 06	W. Crawfish Key..... N. W. Boca Chica.....	151 11 51 72 58 39	7901.3 15048.4	8640.6 16456.5	4.91 9.35
Major Bache's Station on Cottrel's Key.	24 36 22.20	0 02 43.62	255 27 01 294 11 44	N. W. Boca Chica..... Tift's Observatory.....	75 30 36 114 14 37	15023.2 12829.2	16428.9 14029.6	9.33 7.97
Mullet Key.....	24 34 38.38	0 02 22.82	243 28 13 280 31 15	N. W. Boca Chica..... Tift's Observatory.....	63 31 40 100 33 59	15599.1 11307.1	17058.7 12365.1	9.69 7.02
A.....	24 33 22.84	0 00 25.22	358 16 56 229 51 31	W. Crawfish Key..... N. W. Boca Chica.....	178 16 56 49 54 08	2360.4 13930.7	2581.3 15234.2	1.47 8.66
B.....	24 32 39.30	0 02 07.74	261 29 50 340 28 37	Tift's Observatory..... Sand Key.....	81 32 28 160 29 30	10811.4 10764.5	11823.0 11771.7	6.72 6.69
C.....	24 32 36.67	0 02 22.87	261 24 30 280 33 40	Tift's Observatory..... W. Crawfish Key.....	81 27 14 100 34 30	11244.5 3439.9	12296.6 3761.8	6.99 2.14
Middle Ground.....	24 28 52.75	W. 0 00 17.31	221 31 28 178 36 37	Tift's Observatory..... W. Crawfish Key.....	41 33 20 358 36 35	11442.0 6259.5	12512.6 6845.2	7.11 3.89

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Rock Key.....	24 27 18.30	E. 0 01 11.32	203 56 06 82 19 56	Tift's Observatory..... Sand Key	23 57 21 262 19 26	12550.2 2026.8	13724.5 2216.5	7.80 1.26
Eastern Dry Rocks.....	24 27 37.79	E. 0 02 03.10	75 55 09 198 29 11	Sand Key	255 54 18	3574.0	3908.4	2.22
Western Dry Rocks.....	24 26 43.70	W. 0 02 56.23	223 52 33 260 54 06	Tift's Observatory..... Sand Key	18 30 05 43 55 31	11462.6 17395.8	12535.2 19023.5	7.12 10.80
Woman Key.....	24 31 44.70	0 02 22.79	334 35 26 326 15 43	Sand Key	80 55 19	5026.2	5496.5	3.12
Woman Key, West.....	24 31 29.76	0 03 03.86	99 07 09 184 58 13	Middle Ground.....	154 36 25 146 16 36	9372.2 6360.7	10249.2 6955.9	5.82 3.95
Wreck of Brig Moreno (head.)	24 31 09.95	0 03 34.64	98 38 30 190 04 26	Boca Grande..... Cottal's Key	279 05 10 4 58 24	8129.9 8332.0	8890.6 9166.3	5.05 5.21
Man Key.....	24 31 24.00	0 05 15.76	256 13 05 258 58 25	Man Key..... Cottal's Key	278 37 48 10 04 49	2878.8 9100.5	3148.2 9952.0	1.79 5.65
Lavina Bank	24 35 09.93	0 06 37.63	256 48 53 341 39 31	Tift's Observatory..... W. Crawfish Key.....	76 17 00 79 00 27	16456.8 8402.1	17996.7 9188.3	10.23 5.22
Boca Grande.....	24 32 11.57	0 07 49.10	231 04 13 200 07 22	Cottal's Key	76 50 33 161 40 05	6921.5 7322.5	7569.1 8007.7	4.30 4.55
Boca Grande, East	24 31 45.82	0 07 15.79	130 12 27 189 42 11	Cottal's Key..... Lavina Bank.....	51 06 23 20 07 52	11247.1 5844.1	12299.5 6390.9	6.99 3.63
Mule Key	24 34 46.20	W. 0 04 22.98	231 58 59 50 38 56	Boca Grande	310 12 12 9 42 27	1227.2 6370.6	1342.0 6966.7	0.76 3.96
				Cottal's Key..... Boca Grande.....	51 59 43 230 37 30	3746.7 7501.3	4097.3 8203.2	2.33 4.66

United States Coast Survey.—Geographical Positions. Section VI.—Florida Keys. Sketch F.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Marquesas, Alpha.....	24 34 23.87	W. 0 13 21.99	293 28 04 262 52 40	Boca Grande..... Lavina Bank.....	113 30 23 82 55 28	10213.4 11463.9	11169.1 12536.6	6.34 7.12
Marquesas, Beta.....	24 32 54.59	0 14 20.45	210 54 50 252 14 31	Alpha..... Lavina Bank.....	30 55 14 72 17 44	3201.8 13671.3	3501.4 14950.5	1.99 8.49
Marquesas, Gamma.....	24 34 11.63	0 16 41.39	300 51 29 266 08 49	Beta..... Alpha.....	120 52 27 86 10 12	4619.8 5622.7	5052.1 6148.8	2.87 3.49
Marquesas, Delta	24 35 13.11	0 16 04.95	345 45 58 288 16 32	Epsilon..... Alpha.....	165 46 13 108 17 39	4179.0 4828.2	4570.0 5280.0	2.60 3.00
Marquesas, Epsilon.....	24 33 01.44	0 15 28.43	276 16 50 136 27 17	Beta..... Gamma	96 17 18 316 26 47	1924.4 2979.5	2104.5 3258.3	1.19 1.85
Marquesas, Theta	24 32 49.41	W. 0 16 53.69	261 13 32 187 47 28	Epsilon..... Gamma	81 14 08 7 47 33	2427.6 2553.2	2654.8 2792.1	1.51 1.59
CAPE FLORIDA AND KEY BISCAYNE BAY.								
Cape Florida Station	25 39 52.18	0 00 00.00	.....	.....	.....	.....	.....	.....
Cape Florida Light-house ...	25 39 55.85	W. 0 00 00.41	354 12 13	Cape Florida Station	174 12 13	113.6	124.2	0.07
Soldier Key.....	25 35 23.23	0 00 18.22	183 30 49	Cape Florida St.	3 30 57	8291.1	9066.9	5.15
Elliott's Beach.....	25 41 22.18	W. 0 05 36.66	286 24 58 321 10 35	Cape Florida St. Soldier Key	106 27 24 141 12 35	9786.8 14172.5	10702.6 15498.6	6.08 8.81
Key Biscayne.....	25 42 36.54	E. 0 00 13.73	4 19 42 76 50 11	Cape Florida St. Elliott's Beach.....	184 19 36 256 47 39	5071.9 10032.2	5546.5 10970.9	3.15 6.23

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth.			Distance.		
					° ' "			Metres.	Yards.	Miles.
Bear Cut.....	25 44 08.93	E. 0 00 39.98	8 02 01 63 58 36	Cape Florida St..... Elliott's Beach.....	188 01 45 243 55 54			7978.4 11685.4	8724.9 12778.8	4.96 7.26
Shoal Point.....	25 38 18.35	W. 0 06 52.97	255 54 10 200 37 00	Cape Florida St..... Elliott's Beach.....	75 57 09 20 37 33			11873.8 6043.5	12984.8 6609.6	7.38 3.76
Pearl Oyster Bank.....	25 38 39.55	0 01 56.67	235 30 25 129 13 10	Cape Florida St..... Elliott's Beach.....	55 31 16 309 11 35			3947.4 7916.5	4316.8 8657.3	2.45 4.92
West Point.....	25 42 36.61	0 01 15.60	72 32 51 8 55 29	Elliott's Beach..... Pearl Oyster Bank.....	252 30 58 188 55 11			7629.5 7383.7	8343.4 8074.6	4.74 4.59
Cormorant Point.....	25 44 14.10	0 03 30.28	33 40 01 308 37 24	Elliott's Beach..... West Point.....	213 39 06 128 38 23			6385.7 4805.3	6983.2 5254.9	3.97 2.99
Lewis' Point.....	25 45 26.00	0 02 02.02	38 34 54 346 03 36	Elliott's Beach..... West Point.....	218 33 20 166 03 56			9595.8 5370.5	10493.6 5873.0	5.96 3.34
Northwest Point.....	25 43 33.67	0 00 10.15	46 06 40	West Point..... Cormorant Point.....	226 06 12			2531.7 5715.0	2768.6 6249.8	1.57 3.55
Miami.....	25 46 15.64	0 01 55.49	350 37 45 329 29 52	West Point..... Northwest Point.....	170 38 06 149 30 38			6830.8 5784.8	7470.0 6326.1	4.24 3.60
Miami Channel Mark.....	25 45 00.01	0 01 46.70	348 52 57 314 38 08	West Point..... Northwest Point.....	168 53 11 134 38 50			4497.0 3782.0	4917.8 4135.9	2.79 2.35
Virginia Key.....	25 44 10.38	0 00 19.99	28 14 41 346 21 31	West Point..... Northwest Point.....	208 14 17 166 21 35			3275.5 1163.2	3582.0 1272.0	2.04 0.72
Southwest Point.....	25 41 06.00	W. 0 01 17.65	93 57 35 181 10 42	Elliott's Beach..... West Point.....	273 55 43 1 10 43			7238.1 2788.6	7915.4 3049.5	4.50 1.73

United States Coast Survey.—Geographical Positions. Section VI.—Key Biscayne Bay. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Beasley	25 43 18.94	W. 0 05 17.44	305 41 34 278 01 30	Cape Florida St..... Key Biscayne.....	125 43 51 98 03 54	10899.5 9322.7	11919.4 10195.0	6.77 5.79
Channel Barrel, (C. Florida)	25 40 20.73	0 01 40.05	106 00 25 189 15 29	Elliott's Beach..... West Point	285 58 43 9 15 40	6862.7 4236.1	7504.9 4632.5	4.26 2.63
Channel Stake, (C. Florida).	25 39 42.72	0 00 31.03	251 24 10 109 46 18	Cape Florida St..... Elliott's Beach.....	71 24 23 289 44 06	912.8 9054.6	998.2 9901.8	0.57 5.63
Middle Bank	25 37 40.89	0 00 19.28	187 34 55 359 35 54	Cape Florida St..... Soldier Key	7 35 03 179 35 53	4075.6 4235.7	4457.0 4632.0	2.53 2.63
James' Creek.....	25 39 37.11	0 06 34.66	206 34 25 267 33 49	Elliott's Beach..... Cape Florida St.....	26 24 50 87 36 40	3614.8 11015.2	3953.0 12045.9	2.25 6.84
Sands' Point.....	25 30 08.37	0 02 02.88	196 46 24 151 46 52	Soldier Key	16 47 09	10119.1	11066.0	6.29
				Shoal Point	331 44 47	17113.1	18714.3	10.63
Black Point	25 32 07.51	0 09 27.60	286 25 24 200 42 10	Sands' Point..... Shoal Point	106 28 36 20 43 17	12946.4 12199.1	14157.8 13340.6	8.04 7.58
Black Ledge	25 35 27.89	0 05 22.81	330 24 24 47 56 58	Sands' Point..... Black Point	150 25 50 227 55 13	11305.2 9202.5	12363.0 10063.6	7.02 5.72
Hunting Grounds	25 34 05.25	0 08 47.91	260 23 37 302 47 03	Soldier Key	80 27 17	14424.1	15773.9	8.96
				Sands' Point.....	122 49 58	13452.7	14711.5	8.36
Ragged Key, No. 1.....	25 32 30.69	0 00 49 68	189 23 15 87 12 21	Soldier Key	9 23 30	5380.6	5884.1	3.34
				Black Point	267 08 38	14475.4	15829.9	8.99
West Featherbed Bank.....	25 31 12.90	W. 0 06 04.53	231 26 00 286 22 44	Soldier Key	51 28 29	12360.7	13517.3	7.68
				Sands' Point.....	106 24 29	7034.5	7692.7	4.37

United States Coast Survey.—Geographical Positions. Section VI.—Key Biscayne Bay. Sketch F.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Turkey Point	25 26 17.13	W.0 09 39.79	240 49 57 181 47 42	Sands' Point..... Black Point	60 53 14 1 48 34	14678.7 10786.4	16052.2 11795.7	9.12 6.70
Pelican Bank.....	25 26 35.69	0 07 54.03	236 16 03 165 38 59	Sands' Point..... Black Point	56 18 34 345 38 19	11790.4 10539.1	12893.6 11525.3	7.33 6.55
Rubicon Point	25 23 45.24	0 05 28.32	205 56 55 123 38 30	Sands' Point..... Turkey Point	25 58 21 303 36 42	13111.1 8438.8	14337.9 9228.4	8.15 5.25
Elliott's Key, No. 1.....	25 29 04.25	0 01 14.43	187 39 45 112 17 47	Soldier Key	7 40 09	11766.3	12867.3	7.31
				Black Point	292 14 15	14879.9	16262.2	9.25
Elliott's Key, No. 3.....	25 25 34.84	0 03 21.96	194 42 12 97 02 57	Sands' Point..... Turkey Point	14 42 46 277 00 15	8701.2 10636.0	9515.4 11631.2	5.41 6.61
Coon Point.....	25 28 15.40	0 02 10.43	120 21 28 73 51 31	Black Point	300 18 20	14142.5	15465.8	8.79
				Turkey Point	253 48 18	13069.4	14292.3	8.12
Fender Point.....	25 30 06.96	0 10 22.97	202 37 22 350 19 05	Black Point	22 37 46	4018.8	4394.9	2.50
				Turkey Point	170 19 23	7173.8	7845.1	4.46
Convoy Point.....	25 27 46.62	W.0 10 37.80	193 43 13 329 31 02	Black Point	13 43 43	8263.3	9036.5	5.13
				Turkey Point	149 31 27	3195.2	3494.2	1.99

United States Coast Survey.—Geographical Positions. Section VIII.—Primary Stations. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
DAUPHIN I'd Base { E. End W. End	30 15 02.38 30 14 27.48	W. 0 06 51.09 0 13 27.90	264 11 19.4	Base East.....	84 14 39.3	10661.7	11659.3	6.62
2 Cat Island	30 19 02.22	0 11 15.18	316 16 59.2 22 45 22.7	Base East..... Base West.....	136 19 12.4 202 44 15.7	10214.3 1172.5	11170.0 10030.8	6.34 5.70
Cedar Point.....	30 20 50.44	0 05 53.84	8 07 37.6 45 50 50.8	Base East..... Base West.....	188 07 08.7 225 47 02.2	10825.6 16918.3	11838.6 18501.3	6.73 10.51
Fort Morgan	30 13 48.23	0 00 00.00	93 15 32.1 143 59 45.9	Base West..... Cedar Point.....	273 08 45.3 323 56 47.5	21633.0 16074.6	23657.2 17578.7	13.44 9.99
Point aux Pines.....	30 22 09.79	0 17 28.39	335 41 27.7 300 03 54.5 277 27 19.8	Base West..... Cat Island..... Cedar Point.....	155 43 29.1 120 07 04.1 97 33 10.7	16617.1 11519.0 16705.6	17078.4 12596.8 20455.9	9.70 7.16 11.62
Petit Bois.....	30 12 15.28	0 22 23.26	254 05 26.4 203 16 02.1	Base West..... Point aux Pines.....	74 09 55.8 23 18 30.8	14882.4 19928.6	16275.0 21793.3	9.25 12.38
Grande Batture.....	30 19 31.78	0 23 50.78	299 19 45.8 244 29 44.4 350 07 22.3	Base West..... Point aux Pines..... Petit Bois.....	119 25 09.9 64 32 57.4 170 08 06.4	19100.1 11311.2 11641.5	20887.3 12369.6 14917.9	11.87 7.03 8.48
Horn Island East	30 13 21.15	0 30 33.50	278 45 40.9 223 17 41.4	Petit Bois..... Grande Batture.....	98 49 47.6 43 21 04.4	11264.4 11685.6	14505.5 17153.3	8.24 9.75
Bayou Casotte	30 19 50.49	0 29 24.41	273 40 42.8 321 12 20.8 8 45 34.0	Grande Batture..... Petit Bois..... Horn Island East.....	93 43 31.3 141 15 53.0 188 45 03.9	8929.5 11975.5 19129.3	9765.0 19657.5 13264.2	5.55 11.17 7.54
East Pascagoula	30 20 41.51	W. 0 31 22.28	354 30 19.8 296 30 48.6	Horn Island East..... Bayou Casotte	174 30 44.4 116 31 48.2	11621.7 3518.1	14896.3 3847.3	8.46 2.19

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

418

S. Doc. 3.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
MOBILE BAY.	° ' "	° ' "	° ' "		° ' "			
Sand Island Light.....	30 11 17.62	W. 0 01 33.16	208 14 14 107 03 25	Fort Morgan West Base	28 15 01 286 57 25	5264.3 19986.8	5756.9 21857.0	3.27 12.42
Pelican Island	30 13 15.52	0 64 26.38	308 04 04 261 55 52	Sand Island Light Fort Morgan	128 05 31 81 58 06	5885.8 7193.6	6436.6 7866.7	3.66 4.47
Mobile Point Light.....	30 13 45.64	0 00 03.44	228 27 15 82 31 00	Fort Morgan..... Pelican Island	48 27 17 262 28 47	123.2 7091.4	134.7 7754.9	0.08 4.41
Camp Dauphin.....	30 14 56.51	0 06 44.33	308 59 04 280 58 40	Sand Island Light..... Fort Morgan.....	129 01 41 101 02 04	10708.4 11012.0	11710.4 12042.4	6.65 6.84
Dauphin Island East.....	30 14 59.80	W. 0 03 04.54	294 03 21 157 16 51	Fort Morgan Cedar Point	114 04 54 337 15 23	5403.2 11705.7	5908.8 12801.0	3.36 7.27
Mobile Beach.....	30 13 56.16	E. 0 03 45.85	60 14 37 87 42 11	Sand Island Light Fort Morgan	240 11 57 267 40 18	9828.6 6043.2	10748.3 6608.7	6.11 3.75
Navy Cove	30 14 45.81	0 03 38.09	73 06 19 92 19 20	Fort Morgan. Dauphin Island East.....	253 04 30 92 17 25	6093.5 10771.1	6663.7 11779.1	3.79 6.66
Mullet Point.....	30 24 45.53	E. 0 06 55.00	70 37 39 28 44 24	Cedar Point Fort Morgan.	250 31 11 208 40 55	21764.0 23075.5	23800.4 25234.7	13.52 14.34
Point Juliet.....	30 22 58.20	W. 0 05 00.71	260 08 07 334 35 55	Mullet Point..... Fort Morgan.	80 14 09 154 38 27	19386.6 18742.9	21200.5 20496.7	12.04 11.65
Fowl River Point.....	30 28 21.60	W. 0 04 24.74	290 05 57 5 30 24	Mullet Point..... Point Juliet	110 11 42 185 30 06	19316.6 10004.0	21124.1 10940.1	12.00 6.22

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Great Point Clear.....	30 29 04.57	E. 0 05 10.69	340 45 38 85 06 48	Mullet Point..... Fowl River Point.....	160 46 31 265 01 56	8447.4 15403.3	9237.8 16844.6	5.25 9.57
Dog River Point	30 35 46.90	W. 0 02 17.80	315 59 30 13 52 15	Great Point Clear..... Fowl River Point.....	136 03 18 193 51 11	17214.9 14122.7	18825.7 15444.2	10.70 8.77
Ragged Point.....	30 35 11.66	E. 0 06 28.43	94 27 47 10 23 35	Dog River Point..... Great Point Clear.....	274 23 20 190 22 55	14059.9 11491.5	15375.5 12566.8	8.74 7.09
Deer River Point	30 32 25.17	W. 0 03 29.21	293 58 59 252 06 48	Great Point Clear..... Ragged Point.....	114 03 23 72 11 52	15174.3 16729.9	16594.2 18295.3	9.43 10.39
Alabama City.....	30 31 54.37	E. 0 06 56.95	70 13 00 172 52 29	Fowl River Point..... Ragged Point.....	250 07 52 352 52 15	19320.7 6122.2	21128.5 6695.1	12.00 3.80
Choctaw Point.....	30 40 11.21	W. 0 00 41.57	308 49 23 17 29 00	Ragged Point..... Dog River Point.....	128 53 02 197 28 11	14703.2 8532.6	16079.0 9331.0	9.13 5.30
Point Zeb	30 38 10.98	E. 0 06 14.67	356 11 58 108 30 09	Ragged Point..... Choctaw Point.....	176 12 05 288 26 37	5533.5 11683.6	6051.6 12776.3	3.44 7.27
Garrow's Bend.....	30 39 07.04	W. 0 02 19.69	277 08 50 232 53 31	Point Zeb..... Choctaw Point.....	97 13 12 52 54 21	13802.4 3275.2	15093.9 3581.7	8.58 2.04
Choctaw Point Light	30 40 11.06	W. 0 00 42.53	308 44 48 288 22 55	Ragged Point..... Point Zeb.....	128 48 28 108 26 30	14720.1 11706.0	16097.5 12701.3	9.15 7.27
Apalacha River	30 39 52.84	E. 0 04 03.41	335 56 59 311 53 55	Ragged Point..... Point Zeb.....	155 58 14 131 55 02	9480.2 4695.8	10367.3 5135.2	5.89 2.92
Vessel Point.....	30 40 32.19	E. 0 06 07.73	357 33 58 56 54 22	Point Zeb..... Dog River Point.....	177 34 01 236 50 04	4352.1 16073.2	4859.3 17577.2	2.70 9.99

United States Coast Survey.—Geographical Positions. Section VIII.—Mobile Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Crab Creek	30 43 03.18	E. 0 01 28.28	301 59 47 33 08 03	Vessel Point.....	122 02 10	8769.9	9590.6	5.45
				Choctaw Point.....	213 06 56	6323.1	6914.8	3.93
Blakely	30 44 16.17	0 05 32.03	70 53 55 352 09 23	Crab Creek	250 51 51	6862.5	7504.6	4.26
				Vessel Point.....	172 09 41	6962.2	7613.7	4.33
Tensaw River	30 41 35.62	E. 0 01 48.66	168 37 43 311 38 51	Crab Creek	348 37 33	2750.4	3007.8	1.71
				Point Zeb	131 41 07	2478.4	10365.3	5.89
Mobile, Episcopal Spire.....	30 41 26.25	W. 0 01 04.24	243 34 36 278 12 35	Blakely	63 37 58	11769.5	12870.8	7.31
				Vessel Point.....	98 16 15	11615.8	12702.7	7.22
Mobile, Barton Academy.....	30 41 23.75	0 01 28.13	312 02 48 277 25 31	Ragged Point.....	132 06 51	17096.3	18696.0	10.62
				Vessel Point.....	97 29 24	12235.2	13380.1	7.60
Opposite Mobile Island	30 42 02.69	W. 0 00 41.99	281 44 13 359 48 53	Tensaw River.....	101 45 29	4094.6	4477.7	2.54
				Choctaw Point.....	179 48 53	3432.8	3754.0	2.13
Minetta Bay.....	30 42 29.09	E. 0 05 26.37	343 00 01 99 25 43	Vessel Point.....	163 00 22	3764.2	4116.4	2.34
				Crab Creek	279 23 41	6420.5	7021.3	3.99
Middle Apalacha.....	30 42 51.01	0 04 54.91	61 14 00 93 54 52	Choctaw Point.....	241 11 08	10217.0	11173.0	6.35
				Crab Creek	273 53 06	5509.9	6025.5	3.42
Middle Tensaw	30 43 12.78	0 02 42.33	44 09 09 246 36 06	Choctaw Point.....	224 07 25	7791.1	8520.1	4.84
				Blakely	66 37 33	4918.2	5378.4	3.06
Spanish River	30 43 32.37	0 00 21.45	296 48 57 15 09 07	Crab Creek	116 49 31	1992.2	2178.6	1.24
				Choctaw Point.....	195 08 35	6417.3	7017.8	3.99
Upper Tensaw.....	30 44 47.11	E. 0 03 50.32	40 25 55 289 23 04	Choctaw Point.....	220 23 36	11158.3	12202.4	6.93
				Blakely	109 23 56	2868.0	3136.4	1.78

United States Coast Survey.—Geographical Positions. Section VIII.—Bonsecours Bay. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
St. Louis Point	30 44 04.70	W. 0 01 21.75	202 57 38 292 42 56	Mobile River	22 58 12	4556.3	4982.6	2.83
Opposite Chickasaw Bayou ..	30 44 26.93	0 00 57.37	303 38 18 356 56 36	Crab Creek	112 44 23	4903.6	5362.4	3.05
Mobile River	30 46 20.94	W. 0 00 14.90	335 44 03 3 34 05	Crab Creek	123 39 32	4654.1	5089.6	2.89
				Choctaw Point	176 56 44	7885.5	8623.4	4.90
				Crab Creek	155 44 56	6679.2	7304.2	4.15
				Choctaw Point	183 33 51	11407.0	12474.4	7.09
BONSECOURS BAY.								
Little Point Clear, No. 1.....	30 15 50.84	E. 0 05 18.10	188 55 34 128 34 00	Mullet Point.....	8 56 23	16665.5	18224.9	10.35
Cypress Point	30 20 03.45	0 12 48.17	132 40 28 57 08 09	Point Juliet.....	308 28 48	21127.2	23104.1	13.13
Fish River	30 22 59.00	0 09 44.12	317 42 26 347 33 34	Mullet Point.....	312 37 30	12819.6	14019.1	7.96
Shell Bank Bayou	30 15 13.75	0 11 42.35	96 22 18 191 08 58	Little Point Clear, No. 1.....	237 04 22	14321.1	15661.1	8.90
Oyster Cove.....	30 14 25.80	0 08 51.85	252 02 17 114 38 11	Cypress Point	137 43 59	7305.4	7989.0	4.54
Bonsecours Bay.....	30 17 50.79	0 15 41.20	52 52 19 131 28 46	Shell Bank Bayou	167 34 34	14669.8	16042.5	9.11
New Bonsecours Harbor	30 17 51.97	E. 0 15 41.00	131 23 44 52 45 11	Little Point Clear, No. 1.....	276 19 05	10333.7	11300.6	6.42
				Cypress Point	11 09 31	9091.7	9942.4	5.65
				Shell Bank Bayou	72 03 43	4790.8	5239.1	2.98
				Cypress Point	294 36 23	6285.1	6873.2	3.91
				Cypress Point	232 50 19	8007.8	8757.1	4.98
				Shell Bank Bayou	311 27 19	6168.3	6745.5	3.83
				Cypress Point	311 22 16	6153.2	6729.0	3.82
				Shell Bank Bayou	232 43 10	8013.7	8763.6	4.98

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
West Gulf Shore.....	30 13 54.57	E. 0 13 06.10	269 30 56 137 40 08	New Bonsecours Harbor	29 32 14 317 39 26	8400.5 3324.4	9186.5 3635.5	5.22 2.06
East Gulf Shore.....	30 14 15.29	E. 0 18 22.77	85 42 50 147 03 59	West Gulf Shore	265 40 11 327 02 37	8490.3 7950.2	9284.7 8694.1	5.28 4.94
MISSISSIPPI SOUND.								
Grant's Pass Light-house....	30 17 37.22	W. 0 07 04.16	355 48 36 60 21 32	East Base.....	175 48 43	4780.6	5227.9	2.97
				West Base	240 18 19	11803.2	12907.6	7.33
Grant's Pass	30 17 41.56	0 06 39.53	3 36 32 61 19 35	East Base.....	183 36 22	4911.2	5370.7	3.05
				West Base	241 16 09	12443.2	13607.5	7.73
Little Dauphin Island	30 16 53.74	0 05 40.80	28 43 49 113 54 09	East Base.....	208 43 13	3910.0	4275.9	2.43
				Cat Island.....	293 51 39	9771.4	10685.7	6.07
John's House.....	30 18 44.55	0 06 40.49	2 21 44 54 00 22	East Base.....	182 21 39	6847.2	7487.9	4.25
				West Base	233 56 57	13461.4	14721.0	8.36
Marsh Island	30 19 24.09	0 14 00.18	354 36 08 278 40 28	West Base	174 36 24	9173.3	10031.7	5.70
				Cat Island.....	98 41 51	4458.6	4875.8	2.77
Bayou Coq d'Inde.....	30 22 22.48	0 12 38.94	340 03 24 21 33 16	Cat Island.....	160 04 07	6559.6	7173.4	4.08
				Marsh Island	201 32 35	5905.8	6458.4	3.67
Murder Point.....	30 20 23.96	0 10 30.51	25 21 31 136 46 53	Cat Island.....	205 21 08	2785.7	3046.4	1.73
				Bayou Coq d'Inde,	316 46 12	5007.5	5476.1	3.11
Pass Barron.....	30 19 20.25	W. 0 09 25.69	332 29 45 79 15 32	East Base.....	152 31 09	8950.5	9788.0	5.56
				Cat Island.....	259 14 37	2976.1	3254.6	1.85

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

S. Doc. 3.

423

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Petit Bois East	30 14 01.23	W. 0 15 48.20	128 18 53	Grande Batture	308 14 50	16428.6	17965.8	10.21
			72 52 03	Petit Bois	252 48 44	11056.5	12091.1	6.87
Petit Bois West	30 12 16.44	0 25 50.34	193 23 59	Grande Batture	13 24 59	13779.7	15069.1	8.56
			104 45 42	Horn Island East	284 43 19	7829.8	8562.4	4.86
Bayou Lafourche	30 23 18.32	0 20 31.99	37 17 03	Grande Batture	217 15 23	8765.5	9585.6	5.45
			293 16 36	Point aux Pines	113 18 09	5336.5	5835.8	3.32
Grande Batture East	30 20 59.49	0 22 01.81	47 08 52	Grande Batture	227 07 57	3970.5	4342.0	2.47
			253 27 59	Point aux Pines	53 29 48	7614.9	8327.4	4.73
West Grand Bay	30 22 00.83	0 23 20.52	9 59 21	Grande Batture	189 59 06	4660.0	5096.0	2.90
			313 35 06	Grande Batture East	133 35 46	2819.4	3083.2	1.75
East Grand Bay	30 24 13.38	0 19 07.87	325 05 01	Point aux Pines	145 05 52	4640.5	5074.7	2.88
			37 53 11	Grande Batture East	217 51 52	7563.5	8271.2	4.70
Point aux Chenes	30 19 05.11	0 27 36.88	24 02 08	Horn Island East	204 00 39	11595.0	12680.0	7.20
			326 23 06	Petit Bois	146 25 44	15148.9	16566.4	9.41
Ship Yard	30 20 45.19	0 32 14.93	290 17 01	Bayou Casotte	110 18 28	4855.4	5309.7	3.02
			348 46 49	Horn Island East	168 47 40	13938.5	15242.7	8.68
Round Island	30 18 04.15	0 34 01.08	209 45 12	Ship Yard	29 46 05	5712.1	6246.6	3.55
			246 05 02	Bayou Casotte	66 07 22	8083.5	8839.9	5.02
Round Island Light	30 17 30.51	0 33 44.64	256 42 53	Grande Batture	76 47 53	16297.6	17822.6	10.13
			326 20 44	Horn Island East	146 22 20	9222.4	10085.3	5.73
Horn Island, (1)	30 13 46.73	W. 0 34 45.52	203 01 16	East Pascagoula	23 03 00	13878.1	15176.7	8.62
			276 39 01	Horn Island East	96 41 08	6784.2	7419.0	4.22

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Horn Island, (2)	30 14 14.52	W. 0 37 32.05	231 31 11 278 19 32	Bayou Casotte..... Horn Island East	51 35 17 98 23 02	16637.6 11310.6	18194.4 12368.9	10.34 7.03
Horn Island West.....	30 15 18.86	0 41 45.94	247 03 41 281 21 07	Bayou Casotte..... Horn Island East	67 09 55 101 26 46	21506.2 18338.8	23518.5 20054.8	13.36 11.39
Bayou Gravellines.....	30 21 44.19	0 36 47.69	326 41 29 286 26 39	Round Island..... Bayou Casotte.....	146 42 53 106 30 22	8106.1 12344.5	8864.6 13499.6	5.04 7.67
Bellefontaine	30 20 38.21	0 41 11.48	274 23 57 308 14 33	Bayou Casotte..... Horn Island East	94 29 54 128 19 54	18941.0 21719.0	20713.0 23751.2	11.77 13.49
Ship Island East	30 14 47.53	0 50 10.14	265 52 12 233 05 02	Horn Island West..... Bellefontaine.....	85 56 26 53 09 34	13512.2 17992.7	14776.3 19676.6	8.39 11.18
Deer Island	30 21 36.78	0 47 41.13	320 46 44 17 32 39	Horn Island West..... Ship Island East.....	140 49 43 197 31 24	15014.6 13214.9	16419.6 14451.4	9.33 8.21
Ship Island Main	30 14 34.80	0 51 56.21	207 39 37 262 07 12	Deer Island	27 41 46	14671.9	16044.7	9.12
Chandeleur Light	30 03 21.57	W. 0 51 24.26	214 21 29 177 42 13	Ship Island East	82 08 05	2862.5	3130.4	1.78
				Horn Island West..... Ship Island Main.....	34 26 19 357 41 57	27389.4 21265.7	29952.2 23255.5	17.02 13.21
<i>Biloxi Bay,</i>								
Monk's Point.....	30 21 02.09	W. 0 43 37.70	48 11 51 99 20 57	Ship Island Main..... Deer Island	228 07 39 279 18 54	17877.8 6587.4	19550.8 7203.2	11.11 4.09
Marsh Point.....	30 23 06.89	W. 0 46 52.28	25 10 44 306 28 28	Deer Island	205 10 19	3065.6	3352.9	1.90
				Monk's Point.....	126 30 06	6461.9	7066.6	4.02

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

S. Doc. 3.

425

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.			Distance.	Distance.	Distance.
					°	'	"	Metres.	Miles.	Yards.
Deer Island East	30 21 31.08	W. 0 47 13.09	278 48 25 190 39 51	Monk's Point..... Marsh Point.....	98	50	14 10 40 02	5820.5 3001.8	6365.1 3282.9	3.62 1.86
Point Cadde.....	30 24 23.78	0 50 09.46	294 12 28 318 27 57	Marsh Point..... Deer Island East.....	114	14	08 138 29 26	5771.1 7102.4	6311.0 7766.5	3.59 4.41
Plummer.....	30 24 52.04	0 49 06.18	333 59 05 62 45 04	Deer Island East..... Point Cadde.....	154	00	02 242 44 32	6884.7 1899.7	7529.2 2077.8	4.28 1.18
Point Joli.....	30 25 24.55	0 51 15.81	316 34 30 286 07 59	Point Cadde..... Plummer	136	35	04 106 09 04	2376.1 3601.2	2598.3 3937.9	1.48 2.24
Rhodes' Ship Yard	30 24 48.60	0 51 17.29	268 15 37 182 02 25	Plummer	88	16	44	3500.5	3828.1	2.18
Point Blanc	30 25 21.45	0 53 23.03	268 22 47 286 45 58	Point Joli..... Point Joli	2	03	26	1107.6	1211.7	0.69
Point Blanc	30 25 21.45	0 53 23.03	268 22 47 286 45 58	Point Joli	88	23	51	3395.9	3713.8	2.11
Point Blanc	30 25 21.45	0 53 23.03	268 22 47 286 45 58	Rhodes' Ship Yard	106	47	01	3504.4	3831.9	2.18
Point Pierre.....	30 25 50.04	0 53 20.72	299 51 45 3 59 26	Rhodes' Ship Yard	119	52	49	3798.4	4153.4	2.36
Point Pierre.....	30 25 50.04	0 53 20.72	299 51 45 3 59 26	Point Blanc	183	59	25	882.5	965.6	0.55
Harvey	30 25 06.01	0 55 16.41	261 03 35 246 16 42	Point Blanc	81	04	32	3062.8	3349.6	1.90
Harvey	30 25 06.01	0 55 16.41	261 03 35 246 16 42	Point Pierre.....	66	17	41	3371.7	3687.5	2.09
Marsh Island.....	30 25 25.35	0 55 23.40	272 08 00 342 36 54	Point Blanc	92	09	01	3214.3	3514.7	2.00
Marsh Island.....	30 25 25.35	0 55 23.40	272 08 00 342 36 54	Harvey	162	36	58	624.2	682.4	0.39
Hawley	30 25 33.58	0 57 06.36	286 07 57 275 15 45	Harvey	106	08	53	3054.4	3339.8	1.90
Hawley	30 25 33.58	0 57 06.36	286 07 57 275 15 45	Marsh Island	95	16	37	2759.1	3017.2	1.71
Fowler	30 24 59.32	W. 0 56 52.99	251 27 28 161 18 24	Marsh Island	71	28	13	2521.4	2756.9	1.57
Fowler	30 24 59.32	W. 0 56 52.99	251 27 28 161 18 24	Hawley	341	18	17	1113.7	1218.2	0.69

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.
Bernard's Bayou.....	30 25 02.10	W. 0 58 45.38	249 50 45	Hawley.....	69 51 35	2814.5	3077.3
			271 37 34	Fowler.....	91 38 31	3000.6	3281.8
Chatakabafa Saw Mill.....	30 26 11.80	W. 0 58 03.95	319 40 51	Fowler.....	139 41 27	2926.7	3200.9
			27 15 31	Bernard's Bayou.....	207 15 10	2414.1	2639.9
<i>Mississippi Sound.</i>							
Biloxi Pier.....	30 22 58.89	W. 0 52 29.88	288 08 16	Deer Island.....	108 10 42	8113.1	8872.3
			356 40 54	Ship Island Main.....	176 41 11	15547.4	17002.2
*Biloxi Light.....	30 23 46.2	0 52 44.9	.....	Biloxi Pier.....	.....	1477.5	1615.8
Mississippi City.....	30 22 54.21	1 00 33.95	317 59 39	Ship Island Main.....	138 04 00	20682.1	22617.3
			269 19 34	Biloxi Pier.....	89 23 39	12923.2	14132.4
Cat Island Main.....	30 14 22.02	1 02 41.36	268 38 54	Ship Island Main.....	88 44 19	17251.6	18865.8
			192 10 15	Mississippi City.....	12 11 19	16133.6	17643.2
Montgomery.....	30 23 36.05	0 56 29.99	78 49 33	Mississippi City.....	258 47 30	6638.3	7259.1
			20 12 21	Cat Island Main.....	210 09 14	19733.3	21579.4
Ship Island West.....	30 12 54.46	0 56 36.19	247 33 14	Ship Island Main.....	67 35 35	8098.2	8856.0
			105 27 44	Cat Island Main.....	285 24 40	10129.1	11076.9
Ship Island, (2).....	30 13 16.51	0 52 52.04	211 49 19	Ship Island Main.....	31 49 47	2837.0	3102.5
			83 34 14	Ship Island West.....	263 31 21	6026.8	6590.7
Pitcher Point, (1).....	30 20 02.21	W. 1 09 31.44	249 42 28	Mississippi City.....	69 46 59	15297.9	16729.3
			313 40 47	Cat Island Main.....	133 44 14	15159.4	16577.9

Miles.
1.75
1.86
1.82
1.50
5.04
9.66
0.92
12.85
8.03
10.72
10.02
4.12
12.26
5.03
6.29
1.72
3.74
9.51
9.42

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude. ° ' "	Longitude. ° ' "	Azimuth. ° ' "	To station—	Back azimuth. ° ' "	Distance. Metres.	Distance. Yards.	Distance. Miles.
Pitcher Point, (2).....	30 20 02.70	W. 1 09 31.35	249 45 27 313 43 37	Mississippi City..... Cat Island Main.....	69 49 59 133 47 03	15290.6 15167.4	16721.2 16586.2	9.50 9.42
Point Blanc	30 21 27.62	1 05 31.08	340 54 03 67 50 40	Cat Island Main..... Pitcher Point, (2).....	160 55 29 247 48 39	13866.8 6928.8	15164.5 7577.3	8.61 4.30
Cat Island Light	30 13 56.69	1 08 17.98	265 01 18 170 08 09	Cat Island Main..... Pitcher Point, (2).....	85 04 08 350 07 32	9033.1 11439.0	9878.2 12509.4	5.61 7.11
Cat Island, (3).....	30 12 53.60	1 03 18.27	269 49 52 199 55 16	Ship Island West..... Cat Island Main.....	89 52 15 19 55 35	10751.8 2895.8	11757.9 3166.8	6.68 1.80
Cat Island, (2).....	30 12 41.05	1 03 26.70	267 49 03 210 28 09	Ship Island West..... Cat Island (3)	87 52 30 30 29 13	10984.9 434.6	12012.8 475.3	6.83 0.27
Cat Island, South Spit	30 11 22.78	1 04 38.96	257 42 02 218 47 17	Ship Island West..... Cat Island (2)	77 42 05 38 43 53	13216.1 3089.1	14452.7 3378.2	8.21 1.93
Cat Island, Middle Spit	30 12 50.09	1 05 34.28	115 03 44 274 16 46	Cat Island Light	295 03 26 94 17 50	4832.7 3422.3	5284.9 3742.5	3.00 2.13
South Shell Bank	30 10 57.45	1 11 43.59	224 53 13 250 37 08	Cat Island Light	44 54 57 70 40 13	7789.3 10469.1	8518.2 11448.7	4.84 6.50
Isle au Pied.....	30 10 14.16	1 07 46.59	236 54 45 173 00 45	Cat Island (2)	56 56 07 353 00 29	8294.5 6901.4	9070.6 7547.3	5.15 4.29
Pass Christian Light.....	30 18 54.35	1 13 37.35	316 58 13 295 28 03	Cat Island Light..... Cat Island Main.....	137 03 28 115 35 34	12520.7 19430.1	13692.3 21248.2	7.78 12.07
Pass Christian	30 18 30.22	W. 1 14 43.83	251 08 32 309 12 48	Pitcher Point, (2)..... Cat Island Light-house.....	71 11 10 129 16 03	8819.1 13314.4	9644.2 14559.8	5.48 8.27

United States Coast Survey.—Geographical Positions. Section VIII.—Mississippi Sound. Sketch H.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Merritt's Coquille.....	30 13 45.71	W. 1 15 28.01	219 21 52 268 17 14	Pitcher Point, (2)..... Cat Island Light-house.....	39 24 52 88 20 49	15019.1 11502.5	16424.4 12578.8	9.33 7.15
St. Louis Bay.								
Henderson's Point.....	30 18 24.73	W. 1 16 12.83	303 00 12 352 03 32	Cat Island Light..... Merritt's Coquille.....	123 04 11 172 03 55	15138.5 8674.1	16555.0 9485.6	9.41 5.39
Shieldsboro'	30 17 57.34	1 18 50.70	325 01 27 258 40 50	Merritt's Coquille..... Henderson's Point.....	145 03 09 78 42 10	9453.6 4301.1	10338.6 4703.4	5.87 2.67
Delectable Point.....	30 19 37.47	1 16 09.72	2 07 37 54 22 20	Henderson's Point..... Shieldsboro'	182 07 35 234 20 59	2241.3 5291.4	2450.7 5786.1	1.39 3.29
Coward's Point	30 20 19.36	1 18 34.09	313 04 42 288 28 54	Henderson's Point..... Delectable Point.....	133 05 53 108 30 07	5166.4 4065.8	5649.9 4446.5	3.21 2.53
Cedar Hammock.....	30 22 05.96	1 16 35.99	351 16 26 43 51 31	Delectable Point..... Coward's Point	171 16 39 223 50 31	4625.7 4551.9	5058.8 4977.9	2.87 2.83
St. Louis Bay.....	30 21 55.04	W. 1 20 03.18	321 04 18 266 30 22	Coward's Point..... Cedar Hammock.....	141 05 03 86 32 07	3787.0 5542.1	4141.3 6060.6	2.35 3.44

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

S. Doc. 3.

429

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth,	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
GALVESTON BAY.								
Dollar Point.....	29 26 02.61	W. 6 52 15.00						
Bolivar Point.....	29 22 35.10	6 45 15.02	119 27 49	Dollar Point.....	299 24 23	15999.5	14215.9	8.08
Parr's Grove.....	29 25 50.06	6 40 09.14	91 10 51 53 58 13	Dollar Point..... Bolivar Point.....	271 04 54 233 55 43	15565.8 16199.0	21396.6 11153.3	12.16 6.34
Smith's Point.....	29 31 34.15	6 44 56.82	49 10 40 1 41 38	Dollar Point..... Bolivar Point.....	229 07 05 181 41 29	15604.6 16602.6	17064.7 18156.1	9.70 10.32
Long Grove.....	29 31 58.14	6 42 25.79	341 59 43 79 42 56	Parr's Grove Smith's Point.....	162 00 50 259 41 42	11914.8 4133.0	13029.7 4516.8	7.40 2.57
Fredenberg	29 24 48.28	6 43 07.53	248 24 19 39 58 53	Parr's Grove Bolivar Point.....	68 25 47 219 57 50	5170.8 5350.1	5654.6 5850.7	3.21 3.32
Widow Yates.....	29 23 26.98	6 43 52.33	173 23 46 233 46 26	Smith's Point..... Parr's Grove	353 23 14 53 48 16	15098.6 7456.5	16511.4 8154.2	9.38 4.63
Bunker	29 21 59.99	6 44 25.31	128 53 33 224 15 25	Bolivar Point..... Parr's Grove	308 53 09 44 17 31	1722.2 9892.8	1883.4 10818.5	1.07 6.15
Galveston Court House.....	29 18 14.47	6 46 08.82	184 30 07 214 38 26	Smith's Point..... Parr's Grove	4 30 43 34 41 22	24695.8 17053.2	27006.6 18648.9	15.34 10.59
Galveston Cathedral.....	29 18 17.35	6 46 14.17	145 50 05 191 21 54	Dollar Point..... Bolivar Point.....	325 47 08 11 22 23	17315.7 8093.7	18935.9 8851.0	11.76 5.03
Galveston Episcopal Church..	29 18 11.83	W. 6 46 21.29	158 15 39 215 24 10	Smith's Point..... Parr's Grove	5 16 21 35 27 12	24805.4 17312.9	27126.4 18932.9	15.41 10.76

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Fort Point.....	29 20 04.49	W. 6 44 38.64	131 53 32 168 03 20	Dollar Point..... Bolivar Point.....	311 49 48 348 03 02	16521.3 4739.4	18067.2 5182.9	10.26 2.94
Galveston Beach.....	29 18 32.19	6 44 49.11	78 45 41 174 39 50	Cathedral..... Bolivar Point.....	258 44 59 354 39 37	2340.0 7511.0	2559.0 8213.8	1.45 4.67
West Bay Point.....	29 18 01.38	6 49 08.45	161 15 25 216 45 01	Dollar Point..... Bolivar Point.....	341 13 53 36 46 56	15646.3 10519.6	17109.3 11503.9	9.72 6.54
Virginia Point.....	29 19 12.62	6 52 12.44	179 41 12 240 59 55	Dollar Point..... Bolivar Point.....	359 41 11 61 03 19	12622.5 12869.3	13803.6 14073.6	7.84 8.00
Pelican Island.....	29 21 17.88	6 48 07.14	242 52 01 331 15 11	Bolivar Point..... Cathedral.....	62 53 26 51 16 06	5215.0 6338.2	5703.0 6931.3	3.24 3.94
Wilcox.....	29 22 46.63	6 52 24.60	182 27 21 271 43 31	Dollar Point..... Bolivar Point.....	2 27 26 91 47 01	6039.2 11588.7	6604.3 12673.1	3.75 7.20
Shoal Point.....	29 23 43.24	6 52 12.20	178 59 33 280 32 07	Dollar Point..... Bolivar Point.....	358 59 33 100 35 32	4291.4 11442.0	4692.9 12512.6	2.67 7.11
Hanna's Reef.....	29 28 06.29	6 48 30.29	287 13 03 57 50 54	Parr's Grove..... Dollar Point.....	107 17 10 237 49 03	14139.7 7152.6	15462.8 7821.9	8.79 4.44
Edward's Point.....	29 29 49.07	6 53 23.29	315 24 13 345 12 49	Bolivar Point..... Dollar Point.....	135 28 13 165 13 22	18752.0 7210.7	20506.6 7885.4	11.66 4.48
Heron Grove.....	29 25 15.81	6 55 31.46	202 18 28 254 45 46	Edward's Point..... Dollar Point.....	22 19 31 74 47 22	9094.1 5487.3	9945.0 6000.8	5.65 3.41
Miller's Point.....	29 26 57.91	W. 6 53 55.07	189 13 36 302 15 22	Edward's Point..... Dollar Point.....	9 13 52 122 16 11	5338.8 3189.0	5838.4 3487.4	3.32 1.98

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

S. Doc. 3.

431

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Cedar Point	29 40 09.07	W. 6 51 24.43	326 38 02 9 31 14	Smith's Point.....	146 41 13	18975.7	20751.3	11.79
						19354.0	21161.0	12.02
Vingtune Island.....	29 33 39.04	6 45 39.72	343 16 42 60 28 03	Smith's Point.....	163 17 03	4014.6	4390.3	2.49
						14349.4	15692.1	8.91
Middle Pass	29 30 51.52	6 51 09.06	178 37 16 262 30 50	Cedar Point.....	358 37 09	17170.4	18777.0	10.67
						10108.8	11054.7	6.28
Opossum Pass	29 31 14.60	6 48 28.07	163 55 30 263 56 43	Cedar Point.....	343 54 03	17125.3	18727.7	10.64
						5719.7	6254.9	3.55
Rock Spring.....	29 30 34.01	6 56 47.52	206 07 53 284 06 20	Cedar Point.....	26 10 32	19723.7	21569.3	12.25
						5671.5	6202.2	3.54
Morris	29 34 07.16	6 59 30.83	229 33 01 308 44 16	Cedar Point.....	49 37 01	17185.8	18793.9	10.68
						12690.7	13878.2	7.89
Red Bluff West.....	29 35 03.04	6 58 48.88	231 43 39 317 46 32	Cedar Point.....	51 47 19	15221.4	16645.7	9.46
						13048.6	14269.6	8.11
Red Bluff	29 36 12.39	6 57 44 48	234 29 24 329 11 45	Cedar Point.....	54 32 32	12553.2	13727.8	7.80
						13736.9	15022.2	8.54
Flander's Grove.....	29 32 16.39	6 59 34.76	202 12 42 193 31 42	Red Bluff	22 13 36	7848.4	8583.0	4.88
						5277.1	5770.9	3.28
Houston	29 39 20.63	6 53 26.12	359 45 04 50 11 28	Edward's Point	179 45 06	17596.7	19243.2	10.93
						9048.7	9895.4	5.62
Morgan Point.....	29 40 55.99	W. 6 57 55.41	277 47 52 358 04 17	Cedar Point	97 51 06	10610.4	11603.2	6.59
						8736.3	9553.8	5.43

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	M ^{tres} .	Y ^{ards} .	M ^{iles} .
Mezquit Knoll	29 39 37.02	W. 6 54 31.30	39 31 42 113 54 30	Red Bluff	219 30 06	8 66.4	8930.5	5.07
				Morgan Point	293 52 49	6 02.4	6564.1	3.73
Salt Works	29 40 06.21	6 54 23 02	36 58 54 105 02 12	Red Bluff	216 57 14	9 10.2	9853.3	5.60
				Morgan Point	285 00 27	5 12.1	6465.3	3.67
Pottery	29 40 36.08	6 54 38.02	31 43 10 96 36 00	Red Bluff	211 41 28	9 42.6	10435.5	5.93
				Morgan Point	276 34 22	5 42.0	5841.9	3.32
Clopper	29 40 53.69	6 57 01.38	300 19 00 92 47 23	Mezquit Knoll	120 20 14	4 74.9	5112.4	2.91
				Morgan Point	272 46 57	1 54.4	1590.5	0.90
Hackberry Point	29 37 23.20	6 59 06.90	207 30 19 240 54 50	Clopper	27 31 21	7 306.9	7990.6	4.54
				Mezquit	60 57 07	8 80.3	9273.8	5.27
Dr. Harris	29 37 58.82	6 59 39.66	218 19 05 249 56 57	Clopper	38 20 23	6 62.9	7505.1	4.26
				Mezquit	69 59 30	8 26.6	9652.5	5.48
Dr. Beasley	29 39 34.42	W. 6 59 04.87	233 40 29 269 21 30	Clopper	53 41 30	4 20.7	4506.3	2.56
				Mezquit	89 23 45	7 56.7	8045.1	4.57
<i>San Jacinto River.</i>								
Allen	29 41 11.18	W. 6 54 58.40	345 53 16 84 23 57	Mezquit	165 53 29	2 089.1	3268.8	1.86
				Morgan Point	264 22 29	4 81.5	5228.9	2.97
Dalton Point	29 42 33.73	6 58 39.93	293 05 53 338 18 33	Allen	113 07 43	6 74.4	7080.2	4.02
				Morgan Point	158 18 55	3 38.5	3541.5	2.01
Spilman Island	29 42 03.12	W. 6 59 11.60	222 05 11 315 15 16	Dalton Point	42 05 27	1 69.9	1388.7	0.79
				Morgan Point	135 15 54	2 09.7	3182.0	1.81

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Brinson Point.....	29 42 17.66	W. 7 00 47.87	261 48 17 298 27 52	Dalton Point..... Morgan Point.....	81 49 21 118 29 18	3473.9 5273.8	3799.0 5767.3	2.16 3.28
Dalton's House.....	29 42 59.99	6 58 38.51	2 42 47 69 27 31	Dalton Point..... Brinson Point.....	182 42 46 249 26 27	809.6 3713.0	885.4 4060.4	0.50 2.31
Ship Yard.....	29 42 47.80	6 59 58.75	54 53 56 281 33 15	Brinson Point..... Dalton Point.....	234 53 32 101 33 54	1613.6 2162.2	1764.6 2364.5	1.00 1.34
Scott.....	29 44 12.29	7 00 27.59	325 54 04 8 46 40	Morgan Point..... Brinson Point.....	145 55 19 188 46 30	7297.6 3571.0	7980.4 3905.1	4.53 2.21
Brown's Island.....	29 44 05.87	7 02 02.83	265 34 52 328 50 13	Scott..... Brinson Point.....	85 35 40 148 50 50	2566.5 3893.3	2806.7 4257.6	1.59 2.42
Routh.....	29 42 18.58	7 01 12.96	157 55 18 199 11 56	Brown's Island..... Scott.....	337 54 53 19 12 19	3564.7 3706.9	3898.3 4053.8	2.22 2.30
Drasdo.....	29 44 48.74	7 01 59.99	294 19 25 3 18 19	Scott..... Brown's Island.....	114 20 11 183 18 17	2724.5 1322.1	2979.4 1445.8	1.69 0.82
Pine.....	29 45 04.49	7 02 48.90	290 15 00 325 33 05	Drasdo..... Brown's Island.....	110 15 24 145 33 27	1400.6 2188.5	1531.7 2393.3	0.87 1.36
San Jacinto.....	29 44 49.44	W. 7 03 15.61	237 09 03 304 26 31	Pine..... Brown's Island.....	57 09 16 124 27 07	854.3 2371.4	934.2 2593.3	0.53 1.47
Bay of Anahuac.								
Double Bayou.....	29 40 21.68	W. 6 40 41.35	22 57 23 88 45 26	Smith's Point..... Cedar Point.....	202 55 17 268 40 08	17635.9 17294.5	19286.1 18912.7	10.96 10.75

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Lone (5) Oaks	29 36 32.14	W. 6 41 17.31	112 17 12 187 47 21	Cedar Point	292 12 12	17641.6	19291.2	10.96
				Double Bayou	7 47 39	7132.9	7800.3	4.43
Lawrence Cove.....	29 46 16.60	6 45 34.22	324 13 02 39 36 30	Double Bayou	144 15 27	13466.4	14726.5	8.37
				Cedar Point	219 43 36	14718.0	16095.2	9.14
Umbrella Point	29 40 46.17	6 50 47.68	219 36 10 272 36 25	Lawrence Cove	39 38 46	13207.8	14443.7	8.21
				Double Bayou	92 41 25	16318.6	17845.5	10.14
Fisher	29 43 19.13	6 49 53.68	231 53 29 290 09 54	Lawrence Cove	51 55 38	8857.0	9685.8	5.50
				Double Bayou	110 14 28	15819.6	17299.9	9.83
Barrow Beach	29 44 53.13	6 48 16.55	239 28 41 304 18 25	Lawrence Cove	59 30 02	5061.6	5535.0	3.15
				Double Bayou	124 22 11	14816.1	16202.5	9.20
Alligator Bank.....	29 46 53.66	6 43 54.35	336 43 53 66 57 35	Double Bayou	156 45 29	13125.6	14353.8	8.15
				Lawrence Cove	246 56 45	2914.8	3187.5	1.81
South Pass Trinity River	29 46 18.86	6 41 45.79	351 02 46 89 22 01	Double Bayou	171 03 18	11132.2	12173.9	6.92
				Lawrence Cove	269 20 08	6135.8	6709.9	3.81
Round Point	29 43 57.31	6 40 30.64	2 29 04 117 45 29	Double Bayou	182 28 58	6645.0	7276.8	4.13
				Lawrence Cove	297 42 58	9214.4	10076.6	5.72
Ash Point.....	29 41 20.36	6 40 26.87	12 09 52 137 57 37	Double Bayou	192 09 46	1848.2	2021.1	1.15
				Lawrence Cove	317 49 04	12304.1	13455.4	7.64
Anahuac	29 46 46.51	6 39 23.73	9 59 26 84 44 22	Double Bayou	189 58 47	12030.1	13155.8	7.48
				Lawrence Cove	264 41 18	9993.4	10928.5	6.21
Barrow's House.....	29 44 40.72	W. 6 48 34.42	255 17 30 302 03 56	Anahuac	75 22 03	15291.4	16722.2	9.50
				Double Bayou	122 07 51	15008.7	16413.1	9.33

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch 1.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
McCarty	29 49 21.61	W. 6 38 59.19	7 51 28 61 47 35	Anahuac	187 51 16	4820.5	5271.6	3.00
				Lawrence Cove	241 44 19	12040.2	13166.8	7.48
Fort Anahuac	29 45 30.21	6 40 04.70	99 11 19 205 06 07	Lawrence Cove	279 08 35	8965.9	9804.8	5.57
				Anahuac	25 06 27	2593.9	2836.6	1.61
Van Pradelle's House	29 46 29.91	6 40 31.84	254 23 21 338 21 38	Anahuac	74 23 55	1899.5	2077.2	1.18
				Fort Anahuac	158 21 51	1977.2	2162.2	1.23
North Pass Trinity River	29 48 30.39	6 41 25.94	248 10 43 314 15 09	McCarty's	68 11 56	4243.9	4641.0	2.64
				Anahuac	134 16 10	4582.8	5011.6	2.85
Wiggins	29 49 29.27	W. 6 40 39.82	274 59 09 337 48 43	McCarty	94 59 59	2711.9	2965.7	1.69
				Anahuac	157 49 21	5411.8	5918.2	3.36
<i>East Bay.</i>								
Elm Grove	29 28 49.05	W. 6 38 55.30	19 51 18 117 35 35	Parr's Grove	199 50 42	5858.4	6406.6	3.64
				Smith's Point	297 32 37	10983.0	12010.7	6.83
Stevenson	29 32 50.53	6 38 47.01	9 42 08 76 44 07	Parr's Grove	189 41 28	13132.7	14361.5	8.16
				Smith's Point	256 41 05	10229.9	11187.1	6.36
Shaw	29 27 48.81	6 35 48.18	62 32 57 152 36 28	Parr's Grove	242 30 43	7925.2	8666.8	4.92
				Stevenson	332 34 59	10463.4	11442.5	6.50
Robinson Bayou	29 34 46.98	6 32 46.12	20 51 29 69 46 02	Shaw	200 49 59	13775.9	15064.9	8.56
				Stevenson	249 43 04	10353.8	11322.6	6.43
Rollover	29 30 16.73	W. 6 29 16.14	66 41 54 145 49 18	Shaw	246 38 41	11500.1	12576.2	7.15
				Robinson Bayou	325 47 35	1058.7	1157.8	0.66

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	O ' "	O ' "	O ' "		O ' "	Metres.	Yards.	Miles.
Marsh Point.....	29 31 58.06	W. 6 33 03.20	99 55 25 185 03 03	Stevenson..... Robinson Bayou	279 52 36 15 03 11	9395.7 5220.6	10274.9 5709.1	5.84 3.24
Shell Bank.....	29 33 11.70	6 30 25.97	61 50 03 127 52 45	Marsh Point..... Robinson Bayou	241 48 46 307 51 36	4801.5 4778.1	5250.8 5225.2	2.98 2.97
Muscle Point.....	29 32 05.81	W. 6 38 03.26	88 19 43 30 18 18	Marsh Point..... Rollover	268 17 15 210 17 42	8078.7 3889.5	8834.6 4253.5	5.02 2.42
<i>West Bay.</i>								
Highland Bayou.....	29 21 12.94	W. 6 58 48.31	229 54 31 289 06 19	Dollar Point..... Virginia Point	49 57 44 109 09 33	13855.1 11302.9	15151.5 12360.5	8.61 7.02
Island, East Base	29 12 52.58	6 54 38.11	198 34 05 156 20 46	Virginia Point	18 35 17 336 18 44	16818.9 12342.5	18392.7 13497.4	10.45 7.67
Hall's Bayou	29 17 21.23	7 03 36.27	299 36 50 227 25 17	Island, East Base	119 41 13 47 27 38	16717.7 10547.1	18282.0 11534.0	10.39 6.55
Island, West Base.....	29 08 46.21	7 00 51.64	233 02 40 164 20 49	Island, East Base	53 05 42 344 19 29	12623.6 16466.8	13804.8 18007.6	7.84 10.23
Black Point	29 14 51.60	6 58 53.86	297 55 47 180 43 52	Island, East Base	117 57 52 0 43 55	7817.6 11741.1	8549.1 12839.7	4.86 7.29
Eagle Grove	29 17 29.64	6 50 42.57	36 43 19 142 35 31	Island, East Base	216 41 24 322 34 47	10638.9 3991.2	11634.4 4364.7	6.61 2.48
Slaughter House	29 13 56.94	W. 6 51 58.25	65 21 38 140 31 37	Island, East Base	245 20 20 320 28 08	4750.0 17396.2	5194.5 19024.0	2.95 10.81

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		
						Metres.	Yards.	Miles.
Beach	29 13 57.96	W. 6 51 42.17	67 03 18 175 10 51	Island, East Base	247 01 52	5160.1	5642.9	3.21
				Virginia Point	355 10 36	9721.1	10630.7	6.04
Middle Deer Island	29 16 46.62	6 53 51.89	135 43 56 210 50 05	Highland Bayou	315 41 31	11453.5	12525.2	7.12
				Virginia Point	30 50 54	5234.6	5724.4	3.25
Spillman	29 17 33.40	6 55 58.98	145 57 25 243 26 07	Highland Bayou	325 56 02	8157.8	8921.1	5.07
				Virginia Point	63 27 58	6833.4	7472.8	4.25
Settle's House, (chimney) ...	29 12 27.98	6 55 54.23	132 21 36 249 45 49	Black Point	312 20 09	6563.5	7177.7	4.08
				Island, East Base	69 46 26	2190.8	2395.8	1.36
Green's House	29 16 14.64	6 57 50.76	320 05 05 33 40 47	Island, East Base	140 06 39	8108.5	8867.2	5.04
				Black Point	213 40 17	3072.1	3359.6	1.91
Delesdernier's	29 10 21.13	6 58 12.11	172 17 25 231 05 49	Black Point	352 17 05	8402.3	9188.5	5.22
				Island, East Base	51 07 33	7426.6	8121.5	4.61
Caronkaway Island	29 12 26.33	6 58 17.87	167 44 20 262 13 44	Black Point	347 44 02	4576.6	5004.8	2.84
				Island, East Base	82 15 32	5989.8	6550.3	3.72
Caronkaway Point	29 12 53.13	7 00 39.02	217 53 55 2 34 00	Black Point	37 54 46	4622.0	5054.5	2.87
				Island, West Base	182 33 54	7609.2	8321.2	4.73
Mustang Bayou	29 11 47.85	7 06 20 18	302 13 04 244 51 05	Island, West Base	122 15 44	10494.2	11476.1	6.52
				Black Point	64 54 43	13310.9	14556.4	8.27
West End	29 05 21.95	7 05 33.00	230 23 59 173 52 55	Island, West Base	50 26 16	9868.8	10792.2	6.12
				Mustang Bayou	353 52 32	11954.8	13073.4	7.43
Dr. Jones	29 07 05.47	W. 7 03 11.41	50 13 59 149 37 45	West End	230 12 50	4981.1	5447.2	3.09
				Mustang Bayou	329 36 13	10084.9	11028.5	6.27

United States Coast Survey.—Geographical Positions. Section IX.—Galveston Bay. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Ayres	29 10 34.41	W. 7 07 52.00	338 39 28 227 33 46	West End..... Mustang Bayou	158 40 36 47 34 31	10326.8 3360.7	11293.1 3675.2	6.42 2.09
Mezquit	29 07 47.72	7 08 30.31	313 06 01 205 24 33	West End..... Mustang Bayou	133 07 27 25 25 37	6566.0 8192.3	7180.4 8958.9	4.08 5.09
Bastrop	29 06 28.21	7 10 07.00	285 22 39 211 53 12	West End..... Mustang Bayou	105 24 52 31 55 03	7683.8 11598.7	8402.8 12684.0	4.77 7.21
Peninsula	29 01 22.84	7 10 14.14	181 10 35 225 54 42	Bastrop..... West End.....	1 10 38 45 56 59	9403.0 10583.5	10282.8 11573.8	5.84 6.58
Christmas Point	29 04 51.04	W. 7 09 06.32	15 58 35 260 37 08	Peninsula	195 58 02 80 38 52	6667.0 5846.1	7290.8 6393.1	4.14 3.63
<i>Oyster Bay.</i>								
San Louis	29 04 19.41	W. 7 06 56.37	127 34 52 44 33 25	Bastrop	307 33 19 224 31 49	6503.3 7627.0	7111.8 8340.7	4.04 4.74
Mud Island.....	29 05 43.38	7 07 34.10	108 28 27 28 22 01	Bastrop	288 27 13 208 20 43	4358.3 9114.3	4766.1 9967.1	2.71 5.66
Follet	29 02 30.11	7 09 00.46	166 12 40 43 54 36	Bastrop	346 12 08 223 54 00	7547.6 2874.6	8253.8 3143.5	4.69 1.69
Freshwater.....	29 03 14.94	7 11 30.36	200 44 35 329 08 19	Bastrop	20 45 16 149 08 56	6362.6 4020.1	6958.0 4396.3	4.07 2.49
Cottonwood	29 04 34.18	W. 7 13 41.48	316 23 27 238 47 48	Peninsula	136 25 08 58 49 32	8133.4 6779.0	8894.5 7413.3	5.05 4.21
				Bastrop				

United States Coast Survey.—Geographical Positions. Galveston Bay.—Section IX. Sketch I.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
Rattlesnake	28 58 37.69	W. 7 14 05.00	183 19 01 230 50 55	Cottonwood	3 19 02	10992.7	12021.3	6.83
Oyster Creek	28 59 30.87	7 16 24.98	205 20 16 251 01 10	Peninsula	50 52 47	8054.7	8808.4	5.01
Benson	29 01 05.82	7 11 48.51	258 23 56	Cottonwood	25 21 35	10331.9	11298.7	6.42
Chocolate	29 12 18.87	7 10 17.33	229 17 21 293 08 59	Peninsula	71 04 10	10610.6	11603.4	6.60
Alligator Head	29 10 30.21	W. 7 04 41.71	187 56 46 297 14 00	Cottonwood	334 31 09	7105.0	7769.8	4.41
				Island, West Base	78 24 42	2606.6	2850.5	1.62
				Hall Bayou	49 20 37	14279.2	15615.1	8.87
				Island, West Base	113 13 35	16626.7	18182.5	10.33
				Hall Bayou	7 57 18	12776.2	13971.7	7.94
				Island, West Base	117 15 53	6992.7	7647.0	4.34

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
SAN DIEGO BAY.								
SAN DIEGO BASE, { East End	32 41 17.91	E. 0 01 50.63						
West End	32 41 40.92	0 01 05.52	301 05 29.2	East Base	121 05 53.6	1372.1	1500.5	0.85
Ballast Point	32 41 04.92	0 00 33.38	258 44 52.4 217 03 24.0	East Base West Base	78 45 34.1 37 03 41.4	2051.7 1388.1	2243.7 1518.0	1.28 0.86
Playa	32 42 09.81	0 00 10.78	301 34 14.1 343 35 22.0	East Base Ballast Point	121 35 08.0 163 35 34.3	3052.8 2083.6	3338.5 2278.6	1.90 1.30
Point Loma	32 40 13.34	0 00 05.41	234 01 43.7 182 13 57.4	East Base Playa	54 02 40.5 2 14 00.3	3386.6 3590.2	3703.5 3926.1	2.10 2.23
Fitch's Hill	32 42 56.62	E. 0 00 09.53	319 06 03.0 1 13 27.1	East Base Point Loma	139 06 57.6 181 13 24.9	4022.1 5030.5	4398.5 5501.2	2.50 3.13
Observatory, Transit	32 41 57.96	0 00 00.00 117 13 22.00	293 03 26.1 187 47 36.6	East Base Fitch's Hill	113 04 25.9 7 47 41.8	3131.9 1830.4	3425.0 2001.7	1.95 1.14
Observatory, Azimuth Point	32 41 57.75	W. 0 00 00.11	293 02 12.4 187 53 15.0	East Base Fitch's Hill	113 03 12.2 7 53 20.2	3134.7 1830.7	3428.0 2002.0	1.95 1.14
Old Town	32 44 57.26	E. 0 03 22.54	19 30 39.9 53 31 55.2	East Base Fitch's Hill	199 29 50.2 233 30 10.8	7167.6 6249.4	7838.3 6834.2	4.45 3.88
Black Fish Point	32 40 41.57	E. 0 03 52.66	125 36 46.5 81 39 42.5 174 18 53.6	Fitch's Hill Point Loma Old Town	305 34 46.0 261 37 39.9 354 18 37.3	7146.7 5983.7 7914.6	7815.4 6543.6 8655.2	4.44 3.72 4.92
False Bay	32 44 02.53	W. 0 00 10.85	328 01 51.6 253 06 04.8	East Base Old Town	148 02 57.2 73 08 00.1	5976.3 5805.0	6535.5 6348.2	3.71 3.61

United States Coast Survey.—Geographical Positions. Section X.—Coast of California. Sketch J, No. 10.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.		Distance.
						Metres.	Yards.	
Indian Point.....	32 41 25.21	E. 0 06 10.07	146 16 33.1 76 54 40.2 69 25 55.2	Old Town..... Point Loma..... Black Fish Point.....	326 15 02.5 256 51 23.0 249 24 41.0	7854.4 9753.7 3823.2	8589.3 10666.4 4180.9	4.88 6.06 2.37
New Town.....	32 43 26.07	0 04 45.83	82 50 09.9 15 17 26.5 329 29 09.5	Fitch's Hill..... Black Fish Point..... Indian Point.....	262 47 40.6 195 16 57.8 149 29 55.0	7251.2 5252.6 4321.1	7929.7 5744.1 4725.4	4.51 3.26 2.68
Beach I.....	32 39 06.81	0 05 26.39	140 05 22.8 194 56 30.6	Black Fish Point..... Indian Point.....	320 04 32.2 14 56 54.2	3805.9 4412.0	4160.0 4824.8	3.36 2.74
Choya Point.....	32 39 34.57	0 07 37.88	146 08 09.3 75 59 47.9	Indian Point..... Beach I.....	326 07 21.9 255 58 36.9	4104.3 3531.0	4488.3 3861.4	2.55 1.20
Point San Augustin.....	32 38 10.17	0 07 46.14	115 36 28.7 175 16 02.2	Beach I..... Choya Point.....	295 35 13.3 355 15 57.7	4038.0 2608.5	4415.8 2852.6	2.51 1.62
Beach II.....	32 36 24.06	0 06 34.20	160 35 07.0 209 50 11.4	Beach I..... Point San Augustin.....	340 34 30.4 29 50 50.2	5315.5 3768.1	5812.9 4120.7	3.30 2.34
Santiago.....	32 35 46.85	0 09 09.86	105 46 44.9 153 41 52.7	Beach II..... Point San Augustin.....	285 45 21.0 333 41 07.6	4211.3 4924.5	4605.4 5385.3	2.61 3.06
Bluff Point.....	32 35 48.28	E. 0 07 10.67	139 12 26.2 191 56 24.4	Beach II..... Point San Augustin.....	319 12 06.6 11 56 43.6	1339.7 4467.0	1465.1 4885.0	0.83 2.78
POINT CONCEPTION, COAST SURVEY OBSERVATORY.....	34 26 56.30	120 25 33.00	.....	(Sketch J, No. 3).....	.....	.....	.....	.....
POINT PINOS, COAST SURVEY OBSERVATORY, NEAR MON- TEREY.....	36 37 59.86	121 54 22.00	.....	(Sketch J, No. 4).....	.....	.....	.....	.....

United States Coast Survey.—Geographical Positions. Section X.—Coast of California. Sketch J, No. 9.

Name of station.	Latitude.	Longitude.	Azimuth.	To station—	Back azimuth.	Distance.	Distance.	Distance.
	° ' "	° ' "	° ' "		° ' "	Metres.	Yards.	Miles.
SAN FRANCISCO BAY.								
Point Avisidera.....	37 43 30.57	E. 0 06 00.74						
Yerba Buena.....	37 48 33.46	0 05 53.15	358 51 39	Point Avisidera.....	178 51 44	9339.5	10213.4	5.80
Angel Island.....	37 51 39.40	E. 0 01 59.68						
Presidio Hill.....	37 47 35.60	0 00 00.00 122 26 47.65	258 18 09 201 15 52	Yerba Buena..... Angel Island.....	78 21 45 21 17 05	8820.6 8065.3	9645.9 8820.0	5.48 5.01
Point San José.....	37 48 23.29	E. 0 02 10.02	266 41 29 177 36 18	Yerba Buena..... Angel Island.....	86 43 46 357 36 12	5466.4 6050.8	5977.9 6617.0	3.40 3.76
Fort Point.....	37 48 26.75	W. 0 00 45.53	324 45 53 271 24 33	Presidio Hill..... Point San José.....	144 46 21 91 26 21	1930.4 4295.1	2111.0 4697.0	1.20 2.67
Point Lobos.....	37 47 12.02	0 02 15.98	257 39 33	Presidio Hill.....	77 40 56	3405.0	3723.6	2.12
Point Boneta.....	37 49 09.73	0 04 00.89	285 28 58 324 43 22	Fort Point..... Point Lobos.....	105 30 58 144 44 26	4958.3 4444.7	5422.2 4860.6	3.08 2.76
South Farallone.....	37 41 43.70	W. 0 32 28.10						

APPENDIX No. 13.

Letter of the Secretary of the Treasury, communicating to the Superintendent of the Coast Survey the act of Congress requiring examinations to be made in relation to light-houses, light-boats, beacons, buoys, &c.

TREASURY DEPARTMENT,

March 29, 1851.

SIR: S. Pleasonton, esq., the general superintendent of the light-house establishment, having reported to me that preliminary surveys, as required by 2d, 3d, and 4th sections of an act entitled "An act making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes," approved the 3d March, 1851, are necessary to determine the sites and ascertain more fully what is required by the public exigencies, in reference to all the light-houses, light-boats, beacons, and buoys, for which appropriations are made by the act requiring that the Superintendent of the Coast Survey shall perform this duty on the seaboard, you are directed to cause such examination to be made as will enable you to furnish the information particularly suggested in the 3d section of the act, on the seacoast of Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, North Carolina, Florida, Texas, California, and Oregon.

A newspaper containing the act of Congress herein referred to, the places to be examined, and the objects to be obtained from such examination, is herewith enclosed. When the several localities have been visited, and such examination made as will enable you to comply with the requirements of the act, you will make report to this department of the result of such examinations, having special regard to the inquiries suggested in the 3d section of the act, in every case of proposed expenditure.

It is desirable that this report should describe the kind of structure, or other improvement, authorized by the act, which you would recommend for adoption, and be accompanied by sketches indicating the precise points where they should be placed; and when it is necessary to purchase the sites, the names of the owners should also be stated.

Very respectfully, your obedient servant,

W. L. HODGE,

Acting Secretary of the Treasury.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

AN ACT making appropriations for light-houses, light-boats, buoys, &c., and providing for the erection and establishment of the same, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following appropriations be, and the same are hereby made, and directed to be paid out of any money in the treasury not otherwise appropriated, to enable the

Secretary of the Treasury to carry the provisions of this act into effect: *Provided, however,* If a good title to any land which it may be necessary to use cannot be obtained on reasonable terms, or the exclusive right to such land as cannot be acquired by cession, when the interest of the United States demands it, before the appropriation would by law fall into the surplus fund, in any and all such cases the appropriations shall be applicable to the objects for which they are made, at any time within two years after the first meeting of the legislature in any State wherein such land may be situated, subsequent to the passage of this act, to wit:

MAINE.

For buoys on White's and Thom's ledges, and on Pond Island reef, at the mouth of the Kennebec river, three hundred dollars.

For a light-house on Pond island, at the entrance of Narraguagus bay, four thousand dollars.

MASSACHUSETTS.

For a light-boat on the Shovelful shoals, off Chatham, twelve thousand five hundred dollars.

For eleven buoys in the channel to Commercial Point and Neponset river, in Dorchester, one thousand dollars.

For a light-house at the head of Holmes' Hole harbor, three thousand five hundred dollars.

For a beacon on Fawn bar, near Deer island, Boston harbor, two thousand five hundred dollars.

For two iron spindles on the northeast ledge of the Graves, and on Holmes' ledge, Boston harbor, two thousand dollars.

RHODE ISLAND.

For a light-boat off Brenton's reef, fifteen thousand dollars.

CONNECTICUT.

For a can-buoy on Peafield reef, off Black Rock harbor, in Long Island sound, in addition to a former appropriation in the act of September, eighteen hundred and fifty, one hundred and thirty-five dollars.

NEW YORK.

For a light-house on Flynn's knoll, near Sandy Hook, thirty thousand dollars.

For a light-house on Horse Shoe reef, Niagara river, twenty-five thousand dollars, in addition to the former appropriations.

For a light-house on the pier, at the mouth of Sodus bay, and the removal of the beacon light on said pier to Grassy Point, near Point Glasgow, six thousand dollars.

For a light-house on the northern extremity of Gardiner's island, six thousand dollars.

For a beacon on the Sand spit in the harbor of Sag Harbor, seven hundred dollars.

For the completion of two beacons near Fort Hamilton, two thousand dollars.

For four spar-buoys at Fire Island inlet, three hundred dollars.

MARYLAND.

For a light-house at Fishing Battery, Chesapeake bay, five thousand dollars.

For a light-house on the Bodkin shoal, mouth of the Patapsco river, in addition to the former appropriation, seventeen thousand dollars. (When this is completed, the present light on Bodkin Point to be discontinued.)

NEW JERSEY.

For a fog-bell at the Newark light-house, two hundred and fifty dollars.

For completion of the beacon in Passaic river, four spar-buoys in the same, a spar-buoy at Mill Rock, and a beacon at the Corner Stake, near Elizabethtown Point, eight hundred dollars.

NORTH CAROLINA.

For a buoy on Middle Ground shoal, Beaufort harbor, two hundred dollars.

For a light-house on Beacon island, six thousand dollars.

For a light-boat near Ocracoke channel, fifteen thousand dollars.

For an iron-buoy on Diamond shoal, off Cape Hatteras, eight hundred dollars.

For a floating bell-beacon on Cape Hatteras outer shoals, eight thousand dollars.

For a light-house on the Upper Jetty, in Cape Fear river, including a bridge from the shore to the light-house, thirteen thousand dollars.

OHIO.

For a light-house on Rock or Mouse island, Lake Erie, five thousand dollars.

For a light-house on Green island, Lake Erie, five thousand dollars.

For a beacon-light on Cedar Point, as a range to enter Sandusky bay, five hundred dollars.

For buoys at the entrance of Port Clinton, Lake Erie, two hundred and fifty dollars.

MICHIGAN.

For a light-house at Bengley's harbor, five thousand dollars.

FLORIDA.

For buoys at the entrance of Musquito harbor, five hundred dollars.

OREGON.

For a light-house and fog-signal at Umqua, fifteen thousand dollars.

For fog-signals for the light-houses at Cape Disappointment, Cape Flattery, and New Dungeness, three thousand dollars.

CALIFORNIA.

For a light-house at Humboldt harbor, fifteen thousand dollars.

TEXAS.

For a light-house at Aransas Pass, twelve thousand five hundred dollars.

For three light-houses of the third class at Half Moon shoal, Red Fish bar, and at Clopper's bar, Galveston bay, fifteen thousand dollars.

SEC. 2. *And be it further enacted*, That if such person as the Secretary of the Treasury shall designate shall report, in any of the cases herein provided for, that preliminary surveys are necessary to determine the site of a proposed light-house, or light-boat, beacon, or buoy, or to ascertain more fully what the public exigency demands, the Secretary of the Treasury shall therefore direct the Superintendent of the survey of the coast of the United States to perform such duty on the seaboard, and the colonel of the corps of topographical engineers to perform such duty on the northwestern lakes.

SEC. 3. *And be it further enacted*, That the officer so directed shall forthwith enter upon the discharge of the duty; and after fully ascertaining the facts, shall report: First, whether the proposed facility to navigation is the most suitable for the exigency which exists; and, second, where it should be placed if the interests of commerce demand it: Third, if the thing proposed be not the most suitable, whether it is expedient to make any other kind of improvement: Fourth, whether the proposed light has any connexion with other lights, and if so, whether it cannot be so located as to subserve both the general and the local wants of trade and navigation; and, fifth, whether there be any, and if any, what other facts of importance touching the subject.

SEC. 4. *And be it further enacted*, That all such reports shall, as speedily as may be, be laid before the Secretary of the Treasury; and if such as to authorize the work without further legislation, he shall forthwith proceed with it, otherwise such reports shall be laid before Congress at the next ensuing session; but, in all cases where the person designated by the Secretary of the Treasury, under the second section of this act, does not report such preliminary examination as expedient, the provisions of this act shall without delay be carried into execution.

SEC. 5. *And be it further enacted*, That the salary of the keeper of the Minot's Ledge light shall hereafter be at the rate of one thousand dollars per annum, and the assistants five hundred and fifty dollars per annum.

SEC. 6. *And be it further enacted*, That in case it should be impossible, in the opinion of the colonel of the topographical corps, to obtain a perfect title to the necessary land upon which to build the light-house heretofore ordered to be built at the mouth of the Calumet river, on Lake Michigan, said land shall be appraised by three disinterested persons, under oath, and the light-house shall immediately be built, and the appraised value of said land shall be paid to any person who shall make to the United States what the Attorney General shall consider a perfect title thereto.

SEC. 7. *And be it further enacted*, That hereafter in all new light-houses, and in all light-houses requiring new lighting apparatus, and in all light-houses as yet unsupplied with illuminating apparatus, the lens or Fresnel system shall be adopted, if, in the opinion of the Secretary of the Treasury, the public interest will be subserved thereby.

SEC. 8. *And be it further enacted*, That the Secretary of the Treasury be, and is hereby, authorized and required to cause a board to be convened, at as early a day as may be practicable, after the passage of this act, to be composed of two officers of the navy of high rank, two officers of engineers of the army, and such civil officer of high scientific attainments as may be under the orders or at the disposition of the Treasury Department, and a junior officer of the navy to act as secretary to said board, whose duty it shall be, under instructions from the Treasury Department, to inquire into the condition of the light-house establishment of the United States, and make a general detailed report and programme to guide legislation, in extending and improving our present system of construction, illumination, inspection, and superintendence: *Provided*, That no additional compensation shall be allowed any person serving on said board.

SEC. 9. *And be it further enacted*, That the President be, and is hereby, required to cause to be detailed from the engineer corps of the army, from time to time, such officers as may be necessary to superintend the construction and renovating light-houses.

Approved March 3, 1851.

APPENDIX No. 14.

Letters of the Superintendent of the Coast Survey to the Secretary of the Treasury, applying for information in regard to the light-house matters referred to in the act of Congress.

COAST SURVEY OFFICE, March 31, 1851.

SIR: I have the honor to acknowledge the receipt of yours of March 29, informing me that the Fifth Auditor had reported that preliminary surveys are required in reference to all the light-houses, light-boats, beacons, and buoys, for which appropriations are made by the act of

March 3d, 1851, and directing me, in pursuance of the law, to cause the necessary examinations to be made, and to report what the public exigency demands in the matter.

It is desirable in the execution of the law, and of your instructions, that such papers as may be in the possession of the department, giving information in regard to the necessity for these several objects referred to in the act, should be examined in this office. I would therefore request that you will give the necessary direction for their transfer to me, to be returned when the report is made.

Yours, respectfully,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. HODGE,
Acting Secretary of the Treasury.

COAST SURVEY OFFICE,
Washington City, April 1, 1851.

SIR: I would respectfully request to be informed which of the light-houses and beacons, for which appropriations were made by the act approved March 3, 1851, have been commenced.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. W. L. HODGE,
Acting Secretary of the Treasury.

APPENDIX No. 14, *bis.*

Letters from the Secretary of the Treasury to the Superintendent of the Coast Survey, communicating reports from the Fifth Auditor, in relation to light-house matters referred to in the act of Congress.

TREASURY DEPARTMENT,
April 3, 1851.

SIR: I transmit for your information, and as a reply to the inquiry made in your letter of the 1st instant, an extract from a letter addressed to the department by S. Pleasonton, esq.

I am, very respectfully, your obedient servant,

WM. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent Coast Survey, Washington.

TREASURY DEPARTMENT,
Fifth Auditor's Office, April 3, 1851.

SIR: In answer to your note of the 2d instant, just received, I have the honor to inform you that no step has been taken by me for building any of the light-houses, or light-vessels, for which appropriations were made on the 3d March last; considering it necessary that the several sites should be previously examined and reported upon by the officers to be appointed for the purpose.

And with respect to three which it had been previously determined to build, and for which additional appropriations were necessary, and were made by that act, I was prevented from taking any step towards building them, by a clause in the act requiring the President to cause to be detailed engineers of the army for the purpose of superintending the construction and renovation of light-houses.

I have the honor to be, sir, respectfully, your obedient servant,
 S. PLEASANTON.

WM. L. HODGE, Esq.,
Acting Secretary of the Treasury.

TREASURY DEPARTMENT,
April 5, 1851.

SIR: In further reply to your letter of the 1st instant, I enclose a copy of a letter from the Fifth Auditor, under date of the 2d instant.

Very respectfully, your obedient servant,

WM. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey, Washington, D. C.

TREASURY DEPARTMENT,
Fifth Auditor's Office, April 2, 1851.

SIR: In reply to your note of the 1st instant, requesting me to furnish Professor Bache with such papers as may be in this office giving information as to the necessity and importance of constructing the light-houses and light-boats for which appropriations were made by the light-house law of the 3d March last, I have to state that with three exceptions, which I shall state, I have no knowledge of the reasons on which the several appropriations were made. The Committee on Commerce of the House of Representatives reported the bill, which was not printed, the last night of the session. I had no knowledge of it until passed into a law. It is presumed the committee made the appropriation upon the application of individuals, of which I have no knowledge. Hence I can give Professor Bache no information that would aid him, or the officers under him, in forming an opinion as to the expediency, or otherwise, of building the light-houses, light-boats, buoys, &c., for which appropriations are made. The necessity for the

examination is apparent, however, from the many lights on the coast and lakes, and the fact that, on some parts of the coast, the lights are now so numerous that it is impossible to distinguish one from another, and they are hence becoming a nuisance.

The exceptions referred to above are, the three additional appropriations recommended by this office, viz: For the light-house on Horse Shoe reef, Niagara river, \$25,000; for a light-house on Bodkin shoal, mouth of the Patapsco, (seven-foot knoll,) \$17,000 dollars; for a light-house at the upper jetty, Cape Fear river, including a bridge from the shore to the light-house, \$13,000. These are works which it has been determined to prosecute, and need not, therefore, be examined.

I have the honor to be, sir, respectfully, your obedient servant,

S. PLEASANTON.

WILLIAM L. HODGE, Esq.,

Acting Secretary of the Treasury.

APPENDIX No. 15.

Table showing the results of examinations for sites of light-houses, beacons, buoys, &c., referred to the Superintendent of the Coast Survey by the Secretary of the Treasury, in accordance with acts of Congress.

Section.	State.	No.	Special locality.	Object recommended.	By whom examined.	Report of superintend'nt.
I	Maine	1 {	White's and Thom's ledges.....	Buoys	Lieut. Comm'g Woodhull.....	Recommended July 28
		2	Pond Island reef, mouth of Kennebec.....	..do.....	do.....do.....	Recommended July 28
	Massachusetts..	3	Pond island, Narraguagus bay.....	Light-house	do.....do.....	Recommended July 28
		4	Shovelful shoals, near Chatham	Light-boat	do.....do.....	Recommended Sept. 1
II			Channel to Commercial point and Wepon- set river	Buoys	Lieutenant McBlair	Recommended April 29
		5	Holmes's Hole, Martha's Vineyard.....	Bug-lights	do.....do.....	Recommended July 19
		6	Fawn bar.....	Beacon	do.....do.....	Recommended April 29
		7	Harding's ledge and the Graves, do.....	Spindles, with cones..	do.....do.....	Recommended April 29
		8	Off Brenton's reef, Narragansett bay	Light-boat.....	do.....do.....	Recommended April 29
	Rhode Island ...	9	Peafield reef, off Black rock	Can-buoys	Lieuts. Jenkins and Woodhull.	Recommended April 29
	Connecticut	10	Flynn's knoll, Sandy Hook.....	Light-house	Light-house Board	Recommended June 13
	New York.....	11	Northern extremity of Gardiner's island.....	do.....	Lieuts. Jenkins and Woodhull.	Not recommended.
		12	Sand spit in Sag Harbor.....	Beacon	do.....do.....	Recommended June 13
		13	Fort Hamilton.....	Buoys	do.....do.....	Recommended June 13
		14	Fire Island inlet, Long Island	Spar-buoys	Lieuts. Jenkins and Woodhull.	Recommended April 29
	New Jersey	17	Newark light-house.....	Fog-bell	do.....do.....	Recommended June 13
			Passaic river, near	Spar-buoys	do.....do.....	Already placed.
			Passaic river	Beacon	do.....do.....	Recommended June 13
			Mill Rock.....	Buoy	do.....do.....	Already placed.
			Elizabethtown point.....	Beacon	do.....do.....	Recommended June 13
IV	Maryland	15	Fishing battery, Chesapeake bay	Light-house	Lieutenant Almy.....	Recommended Nov. 20
		16	Bodkin shoal, Patapsco river	do.....	.....	Recommended April 29
	North Carolina..	19	Middle Ground shoal, Beaufort harbor	Buoy	Lieut. Commanding Jenkins..	Recommended April 29
		20	Beacon island.....	Light-house	do.....Maffit.....	Ex'n made, but report not received Nov. 28.
		21	Ocracoke channel.....	Light-boat.....	do.....do.....	
		22	Diamond shoal, off Cape Hatteras.....	Buoy	do.....Jenkins ..	Recommended April 29

STATEMENT—Continued.

Section.	State.	No.	Special locality.	Object recommended.	By whom examined.	Report of superintend'nt.
IV	North Carolina..	23	Outer shoal, off Cape Hatteras.....	Floating bell beacon.	Lieut. Commanding Jenkins..	Recommended April 29
		24	Upper jettee, Cape Fear river.....	Light-house	do..... Maffitt	Recommended Oct. 15
		25	Mosquito inlet, near Mount Pleasant.....	Buoys	do..... Rodgers	Recommended Oct. 1
		29	Aransas pass, near South breakers	Light-house	do..... Craven	Not recommended.
X	California.....	30	Half Moon shoal.....	do.....	do..... do	Recommended June 17
			Red Fish bar.....	do.....	do..... do	Recommended June 17
		28	Clopper's bar, San Jacinto river.....	do.....	do..... do	Recommended June 17
			Humboldt harbor, North spit.....	do.....	do..... Alden.....	Recommended Nov. 19
			Fort Point, San Francisco bay.....	do.....	Assistant Cutts	Recommended Feb. 13
			Alcatraz, or Bird island.....	do.....	do..... do	Recommended Feb. 13
			Point Conception	do.....	Sub-Assistant Harrison	Recommended Mar. 13
			Point Pinos.....	do.....	do..... do	Recommended Mar. 14
			Umpqua.....	do.....	Lieut. Commanding Alden	Report not rec'd Nov. 28
			Umpqua.....	Fog-signal.....	do..... do	Report not rec'd Nov. 28
XI	Oregon	26	Cape Hancock, or Disappointment	Light-house and fog-signal.	Lieutenant Bartlett and Sub-Assistant Harrison.	Recommended Sept. 29
			Cape Flattery.....	do..... do	Lieut. Commanding McArthur	Recommended April 29
		27	New Dungeness.....	do..... do	do..... do	Recommended April 29

APPENDIX No. 16

Letter of the Superintendent to the chiefs of hydrographic parties in the coast survey, enclosing a communication from the secretary of the Light-house Board, asking for suggestions for the improvements and extension of the present light-house establishment, and extracts from their replies.

COAST SURVEY STATION,
Near Portland, Maine, July 30, 1851.

SIR: I have to call your attention to the enclosed communication from the secretary of the Light-house Board, and to ask such information in relation to the subjects embraced in it as your especial experience on the coast survey, or general experience as a seaman, may enable you to furnish. I would suggest that specific answers be framed, when the subjects come within the range of your experience, to the questions addressed, adding such remarks as the introductory part of the letter seems to contemplate. Please address your reply, as a report, to me at Portland, Maine.

Yours respectfully,

A. D. BACHE, *Superintendent, &c.*

TO CHIEFS OF HYDROGRAPHIC PARTIES in Coast Survey.

Extracts from letter of Lieutenant Commanding C. H. McBlair, United States navy, assistant in coast survey, in reply to above letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Massachusetts—Section I.

U. S. SURVEYING STEAMER BIBB,
New Bedford, August 28, 1851.

SIR: I have received your letter of the 30th ultimo, directing my attention to the enclosed communication from the Secretary of the Light-house Board, on subjects belonging to improvements in the navigation of our coast. * * * *

“Additional lights, buoys, beacons, &c., that may be required to render navigation safe and easy.”

The following objects seem to me worthy of the consideration of the Light-house Board:

a. The expediency of substituting a light-house on the ledge called “Sow and Pigs,” standing near the entrance into Buzzard’s bay, for the present light-boat moored in that vicinity, and the light-house on the western side of Cuttyhunk island. The ledge in question is said to be capable of affording a solid foundation of rock for such a structure, and a light of the highest range and power at this point would be invaluable to vessels passing into Buzzard’s bay, the Vineyard sound, or bound westward into Long Island sound. * * * *

c. Placing a floating beacon, with a fog-bell attached, on Davis’ new South shoal.

This shoal lies near the most frequented parts of the ocean, and has occasioned some very disastrous wrecks. It has as little as eight feet water upon it—is swept by very strong tides, and, during the summer

months, almost constantly hidden by fogs. It was designed at one time to erect a beacon upon it, but the great difficulties of the undertaking, arising from the character of the climate and the distance of the nearest port, seem to be regarded as insuperable. It is, however, indispensable to the safety of passing vessels that it should be marked in as distinct a manner as circumstances will admit.

d. A buoy-boat (hereafter to be described) on the Great Rip, one of the most extensive of the Nantucket shoals. A suitable place for this mark would be in the slue or passage near the south end. I would here indicate the shoal itself, the passage in which it was moored, and that on either side of the Rip.

e. A buoy-boat on the small shoal lying to the eastward of the northern end of the Bass Rip, (Nantucket shoals,) to mark the shoal itself and indicate the passage generally between the Bass and Great Rip.

f. A spar-buoy (hereafter to be described) on the sand-spit projecting from Fox's point, (Nashawena island,) at the southern entrance into Quick's Hole. This channel, connecting the Vineyard sound with Buzzard's bay, is constantly used, and the want of a mark showing the spit has occasioned frequent wrecks.

g. A light-boat near Brenton's reef, at the mouth of Newport harbor, already recommended in a special report to you.

h. Three small harbor-lights, to facilitate the entrance into Holmes' Hole harbor, already particularly described in my report to you of the 16th ultimo.

i. Certain spindles, buoys, and beacons, marking the approaches near Dorchester and Boston, already enumerated and described in my reports to you, dated March 1st.

j. A wooden beacon, painted black, on Long island, (Boston harbor,) placed so as to range with the northeast end of Spectacle island, for the safe navigation of the *main* ship channel. For particulars respecting this mark, I beg to refer you to Lieutenant Charles H. Davis' report to you on the subject, of December 24, 1847.

k. A similar beacon on the southeast part of Long island, (Boston harbor,) to range with "Nix's Mate," in order to facilitate the passage through the Broad Sound south channel. In the Coast Survey sailing directions, the range that has been given to answer the same end, is "Nix's Mate on Blue Hill;" but owing to the distance of the latter object, this guide is only available in clear weather. The substitution of the beacon on Long island for Blue Hill, is recommended at the instance of Lieutenant Davis.

l. A buoy-boat on the southwest end of Billingsgate shoal, (Massachusetts bay,) and two spar-buoys on the southern edge of the shoal, planted at regular intervals between the boat and Billingsgate island. Three guides are necessary in the approach to the anchorage under Billingsgate shoal.

m. A spar-buoy on or near a small rock lying to the southward of Wellfleet harbor, and called, on the hydrographical sheet, "Bibb Rock."

* * * * *

Respectfully,

C. H. McBLAIR,

Lieutenant Commanding, and Assistant Coast Survey.

Extracts from letter of Lieutenant Commanding S. Swartwout, United States navy, assistant in coast survey, in reply to foregoing letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Massachusetts—Section I.

U. S. SURVEYING BRIG WASHINGTON,
Off Nantucket Bar, September 4, 1851.

SIR: Your circular letter, dated July 30th, enclosing a communication from the secretary of the Light-house Board, reached me in due course of mail. * * * * *

“Additional lights, buoys, beacons, &c., that may be required to render navigation safe and easy.”

I am only prepared to answer this question so far as it relates to this particular section of our coast. * * * * *

A floating beacon, with a fog-bell attached, on Davis' South shoal.

A buoy-boat (to be hereafter described) on the Great Rip, one of the most extensive and dangerous of the Nantucket shoals.

A buoy-boat on the small shoal lying to the east of the northern end of the Bass Rip, (Nantucket shoals,) to mark the shoal itself, and indicate the passage between the Bass and Great Rip.

A spar-buoy on the sand-spit projecting from Fox's Point, (Nashawena island,) at the southern entrance into Quick's Hole.

Three small harbor or bug-lights, to facilitate the entrance into Holmes' Hole. The expediency and necessity of these additional aids for the protection of our commerce in this quarter, appear to me to be very obvious; and the many disasters and shipwrecks which occur annually from the want of them, I flatter myself will plead strongly in favor of their immediate adoption by our government. I have merely considered it necessary to allude to these additional aids to render navigation safe and easy, as Lieutenant Commanding C. H. McBlair has already very particularly recommended them to your notice—urging their useful effects by very cogent arguments, to which I can add nothing; but, concurring fully with him in his views, it will be necessary for me to refer you to his reports in relation to these matters, as an answer to this question, so far as my knowledge extends from actual observation. * * * * *

Very respectfully, your obedient servant,

S. SWARTWOUT,
Lieutenant Commanding.

Extracts from letter of Lieutenant Commanding J. N. Maffitt, U. S. navy, assistant in coast survey, in reply to above letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of North and South Carolina—Sections IV and V.

U. S. SCHOONER GALLATIN, August 10, 1851.

SIR: I have received your “circular” of the 20th ultimo, enclosing a copy of a letter from the secretary of the Light-house Board.

* * * * *

I propose three sets of bug-lights for Beaufort, N. C.—first, a single light, due north of the present channel buoy; second, a range light, for crossing the bar, or for the first course in; third, a range light on “Lower Bank,” for the second course to anchorage. Two additional buoys are also required to mark out the channel.

A bug-light *is required* for the upper jettee of the Cape Fear river. There should be three spar-buoys in Charleston harbor, one at each end of the “Middle Ground,” the other at “White Point,” to define the end of that spit for the benefit of vessels bound up the Ashley.

A couple of beacons, for a range, should be erected near “Fort Johnson,” as a guide for vessels to clear “Sumter Flats” and the end of the “Middle” when bound in and out of the South city channel.

To render South Edisto serviceable as a harbor of refuge, a second-order light should be placed on Seabrook Point, and three buoys in the channel-way.

Charleston light should be a “fixed light,” with *improved reflectors*. No light should revolve—that is, one of a range for entering a narrow channel, as the loss of it, even for a few seconds, might be attended with danger.

I have frequently experienced the truth of this.

The beacon-light connected with the main light should be increased in brilliancy and shifted further south, to render the range complete for crossing in the best water. A railway for *this* beacon is required, as the bar is materially influenced by northeast storms, and the range consequently changing to southward.

The “Overall beacons” of Charleston harbor are useless, leading a vessel into six feet at low water. I propose that they be shifted to “Fort Sumter,” as a range for the “Swash channel,” one-eighth of a mile south of the “North,” and with the same depth of water. This would enable coasting vessels and steamers that now use the “North channel” to enter the harbor at night by the “Swash.”

A buoy is required on the southwest end of the Rattlesnake shoal.

The lights at Hatteras and Roman are *very poor*; both should be overhauled and furnished with *improved reflectors*.

Bell-boats would be of infinite service at the extreme point of Cape Lookout and the Frying Pan shoal.

The light-boat at Martin’s Industry, South Carolina, should be furnished with *two* good lights, one forward and the other aft, of different elevations, that the boat may not be confounded with St. Helena light-boat. As the light-boat on “Martin’s Industry” is old and unfit for its exposed and dangerous position, I propose that a new light-boat of great capacity, with an additional light, be placed on that shoal, and the present boat be moored off “Hilton Head,” Georgia, to mark the point of “Grenadier shoal,” which lies due north from “Tybee light.” It is a dangerous spot, and a light-boat has repeatedly been called for by the Charleston and Savannah Steamboat Company.

* * * * *

I am, respectfully, your obedient servant,

JOHN N. MAFFITT,

Lieut. Commanding, and Assistant U. S. Coast Survey.

Extracts from letter of Lieutenant Commanding John Rodgers, United States navy, assistant in coast survey, in reply to foregoing letter of the Superintendent, in relation to lights, beacons, and buoys needed on the coast of Florida—Section VI.

UNITED STATES COAST SURVEY OFFICE,
Washington, August 25, 1851.

SIR: In reply to your letter of July 30, enclosing a circular from the Light-house Board, making inquiries in regard to the present condition of the lights and other aids to navigation which have come under my observation, I have the honor to say:

* * * * *

Additional lights are required on the Florida reef. The difficulties of navigation along this reef, arising from the curved shape of the channel, requiring continual change of course; the strength and irregularity of the current; the coral reefs which fringe either shore, and the lowness of the land, added to the vast amount of passing commerce, and the number and value of the wrecks, call for a full illumination. I think four more light-houses, and the shifting of a light-boat, would be sufficient.

I would place them thus: one about Alligator reef, off Indian key; one about Collins' Patches, off Key Vacas; one on Looe key; one half way between Cape Florida and Carysfort reef.

These should all be first-class refracting lights, or possibly, with the latest improvements, second class.

The light-boat now on Carysfort reef might have a proper lantern fitted to her, and be placed on the Rebecca shoals, between the Tortugas and Marquesas keys. The passage between the Tortugas and Marquesas keys is so much frequented by vessels bound into the Gulf of Mexico, as to call for a light-boat to point out the shoals in it.

With these lights, in addition to those now erected, or in progress, vessels could scarcely get on shore upon our side of the Florida channel without having been warned by a light.

With the increased safety there seem incidental advantages. Our shore being better lighted than the opposite one, vessels will keep in our own waters in passing through the Florida channel. The wrecks inevitable to extensive commerce will pay salvage to our citizens, rather than to foreigners; and foreign goods thus introduced, pay duties to our government.

The wrecks brought into Key West amount annually to about \$1,200,000, and those on the Bahama Banks to twice as much.

It is a point with vessels coasting along the southern States to keep as far as practicable within the influence of the Gulf Stream, for time is of so much importance to them that they are willing to risk something to save time. Coasting steamers run from Cape Canaveral shoal to Jupiter inlet, where the trend of the land alters. A light-house would be useful as a point to run for, and to indicate when the change of course had become necessary. Such a light-house may perhaps be made to guard a shoal which lies between Jupiter inlet and Indian river, on which the United States mail steamer Georgia touched. Captain Coste, United States revenue marine, knows that such a shoal

exists. Captain Willey, a ship-owner and master, who has traded for many years along our southern coast, has furnished me with the following information: "Nine miles from land, ten miles E. by S. $\frac{1}{2}$ S. from Indian river, lies a shoal about one mile long and two cable-lengths wide. It has five fathoms water on the north end, and fifteen feet on the south end; ten fathoms inside of it."

"SE. $\frac{1}{2}$ S. from Indian river, and five miles from land, is another shoal with fifteen feet water on it."

"With Gilbert's bar bearing E. $\frac{1}{2}$ N., distant four miles, is another shoal with five fathoms on it."

"A rock, with six or seven feet water on it, lies half a mile ESE. from the south side of Jupiter inlet: five fathoms close alongside of it."

The light-house can only be properly placed after an examination has been made.

A light-house would be useful about Hillsborough inlet, or where it shall be found that the first spur of the Florida reef starts from the main land.

In the distance of one hundred and seventy miles between Cape Canaveral and Cape Florida there is now no light. The two I propose should both, I think, be of the first class refracting lights, unless it should be found that the recent improvement in the second class make them nearly equal to the first.

"Improvements, if any, which particular lights may require, to render them equal to all the wants of commerce and navigation in their respective localities."

Over-estimate of distance, in consequence of dimness of the Tortugas light, is sometimes given as a cause of wreck. Its situation is one of the most important on our whole coast—nearly all the commerce of the Gulf of Mexico passes within sight of it. If additional force be needed to the requirement of a first-class light, it may be found in the military position of the Tortugas. To develop the full usefulness to commerce and the navy, of the extensive fortification now in progress there, as powerful a light as possible seems necessary.

Cape Florida has a good ordinary reflector light. Its position seems to point out as proper a first-class refracting one. I hope it will not be considered foreign to the subject of these lights for me to offer the suggestion, that the Florida channel is the natural outlet of the Mississippi; that the lights along the Florida reef are those in which the western planters of the United States are particularly interested; and that in lessening the danger of getting their produce to market, its price to them will be enhanced.

Cape Hatteras, Cape Lookout, and Cape Fear, seem all positions for first-class lights.

The light-house on Cape Fear is, according to Blunt's Coast Pilot, one hundred and ten feet above the level of the sea. Its range of visibility to an eye eleven feet above the sea, is, by calculation, 12.76 nautical miles. The Frying-pan shoals, off this cape, extend twenty miles from land. An inspection of the chart shows that these shoals should be illuminated. It does not seem practicable to give a tower on Smith island the height necessary to be seen so far. Light-boats are placed

in situations as exposed: it is possible that an examination might discover a sheltered berth for one.

In such situations it may be sound discretion to build screw-pile or other beacons, to be left some years to test their stability; when, if they stand the test satisfactorily, the light may be placed on the beacon and the boat removed.

The light at Cape Canaveral is not sufficient. The tower was built when it was believed that the shoals extended only three or four miles from the cape. Subsequent examination has discovered a shoal, with eight feet water on it, at the distance of eleven nautical miles.

* * * * *

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant U. S. N., and Assistant Coast Survey.

APPENDIX No. 17.

Table of light-houses, beacons, buoys, &c., recommended by chiefs of hydrographic parties of coast survey, for which no appropriations have been made.

Section.	State.	No.	Special localities.	Object recommended.	By whom examined.	Report of superintendent.
I	Maine.....	1	Thomas's reef, near Thom's ledge.....	Buoy.....	Lieut. Commanding Woodhull....	Recomm'd July 28, 1851
		2	Light-house on Monhegan island.....	Fog-whistle.....	do.....do.....	Recomm'd July 28, 1851
		3	Light-house on Petit Menan island.....	do.....	do.....do.....	Recomm'd July 28, 1851
		4	"Sow and Pigs" ledge, entrance to Buzzard's bay.....	Light-house.....	do.....McBlair....	Recommended.
	Massachusetts..	5	Davis's new south shoal, Nantucket.....	Floating beacon.....	do.....do.....	Recommended.
		6	Great rip, Nantucket.....	Buoy-boat.....	do.....do.....	Recommended.
		7	Sand shoal near north end of Bass rip.....	do.....	do.....do.....	Recommended.
		8	Sand spit at south entrance into Quicks' hole.....	Spar-buoy.....	do.....do.....	Recommended.
II	New York.....	9	Long island, Boston harbor.....	Wooden beacons.....	do.....do.....	Recommended.
		10	Billingsgate shoal.....	Buoy-boat.....	do.....do.....	Recommended.
		11	South end of Billingsgate shoal.....do.....	Spar-buoys.....	do.....do.....	Recommended.
		12	Bibb rock, near Wellfleet harbor.....	do.....	do.....do.....	Recommended.
IV	North Carolina..	13	Gedney's and Swash channel, entrance to New York harbor.....	Range-lights.....	Assistant J. B. Glück.....	Recommended.
		14	Beaufort harbor.....	do.....	Lieut. Commanding Maffitt.....	Recomm'd Feb. 27, 1851
V	South Carolina..	15	Beaufort harbor.....	Buoys.....	do.....do.....	Recomm'd Feb. 27, 1851
		16	Middle Ground and White point, Charleston harbor.....	Spar-buoys.....	do.....do.....	Recommended.
		17	Near Fort Johnson, Charleston harbor.....	Beacons.....	do.....do.....	Recommended.
		18	Seabrook point, North Edisto harbor.....	Light-house.....	do.....do.....	Recommended.
VI	Florida.....	19	Channel way to....do.....do.....	Buoys.....	do.....do.....	Recommended.
		20	Southwest end, Rattlesnake shoal.....	do.....	do.....do.....	Recommended.
		21	Rebecca shoal, between Marquesas and Tortugas.....	Beacon.....	Assistant F. H. Gerdes.....	Recommended.
		22	Reef near Sea-horse key.....	Buoy.....	do.....do.....	Recommended.
		23	Alligator reef, off Indian key.....	Light-house.....	Lieut. Commanding Rodgers....	Recommended.

	Collin's patches, off Key Vacas Half way between Cape Florida and Carys- fort reef	Light-house	Lieut. Commanding Rodgers	Recommended.
24				
25	Near Jupiter inlet	do	do	Recommended.
26	Near Hillsborough inlet	do	do	Recommended.
27		do	do	Recommended.
28	Looe key	do	do	Recommended.
29	Entrance to Mobile bay	Seven buoys	do	Recomm'd Aug. 20, 1849
30	Entrance to Mobile bay	Five beacons	do	Recomm'd Aug. 20, 1849
31	Cat and Ship Island harbors	Nine buoys	do	Recomm'd Aug. 20, 1849
32	Aransas pass	Light-boat	do	Recomm'd July 17, 1851
33	Channel of Aransas pass	Buoys	do	Recomm'd July 17, 1851
34	Off Dollar point	do	do	Recomm'd July 17, 1851
35	Rocks in harbor of San Francisco	do	do	Recomm'd July 17, 1851
36	Humboldt harbor, near North spit	Beacon	do	Recommended July 25
				Recommended.

*The beacons and buoys recommended by Lieutenant Commanding Patterson to be placed in this section (VIII) were noticed in the Annual Reports of 1849 and 1850. As they have not yet been acted on, they are again presented in this Report, (Appendix Nos. 35 and 36.)

APPENDIX No. 18.

Letter of Sears C. Walker, Esq., assistant in the United States coast survey, to the Superintendent, communicating an arrangement with the president of the Maine Telegraph Company, to determine the difference in longitude of Cambridge and Halifax.

CAMBRIDGE, MASS.,
September 23, 1851.

DEAR SIR: I enclose you a copy of the letter of H. O. Alden, esq., president of the Main Telegraph Company, to James Eddy, esq., the superintendent of the company. I would suggest that it should be noticed in your annual report to the Secretary of the Treasury.

You will see that I have negotiated for the Coast Survey to have the free use of the line from Cambridge to Calais after 9 p. m., we paying the operators for their time.

Fortunately, the superintendent (Mr. Eddy) was here to-day, in Boston, and I had a personal interview with the president, Mr. Alden, Mr. Eddy, superintendent, and Mr. Saddler, president of the Boston and Portland line. I have also conferred with Mr. J. C. Rowe, chief operator of the Vermont Chemical line, that goes to Cambridge. Mr. Eddy, Mr. Saddler, and Mr. Rowe, have a perfect understanding with each other. The line works now every night from Portland to Halifax. It will only require Mr. Saddler's battery. Add the distance from Cambridge to Portland. Mr. Bond will not need to have any battery except to work the local circuit—say of two cups.

These officers have no doubt of working any good night from Cambridge to Halifax. Mr. Eddy says there will be no need of sending an officer to Calais—he can do all through an operator. You see that so far as our post is concerned, everything is well arranged.

* * * * *

Yours truly,

SEARS C. WALKER.

Prof. A. D. BACHE, LL. D.,
Superintendent U. S. Coast Survey.

BOSTON, September 20, 1851.

DEAR SIR: Allow me to introduce to your acquaintance S. C. Walker, esq., who is an officer of the United States coast survey, and visits Bangor for scientific purposes. Mr. Walker wishes the use of our telegraph line from Portland to Calais, in connexion with the lines from Boston to Halifax, to enable him to make and communicate the results of astronomical observations, &c., &c.; all of which he will better explain to you.

There being no specific appropriation for such purposes, Mr. Walker, in behalf of science, asks the gratuitous use of our wires at night, and after business hours are closed; he paying such of our operators as are required to be employed by him, a reasonable compensation for their night service.

For the benefit of sciences this is, perhaps, one of those contributions which our company ought not to withhold; hence I have encouraged Mr. Walker, that we will not be behind our neighbors in according to him the privileges he asks. I have therefore referred him to you as fully authorized to act in the premises; and whatever you may do will receive my approbation.

Very truly, yours,

H. O. ALDEN,

President Maine Telegraph Company.

JAMES EDDY, Esq., *Bangor, Me.,*

Superintendent Maine Telegraph Company.

APPENDIX No. 19.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the result of an examination by Lieutenant Commanding M. Woodhull, United States navy, into the necessity for certain aids to navigation on the coast of Maine, in accordance with act of Congress, and instructions of the Treasury Department.

COAST SURVEY STATION,

Mount Pleasant, July 28, 1851.

SIR: I have the honor to report that the examination into the necessity of a light-house at Narraguagus bay, (between Passamaquoddy bay and the Penobscot river, Maine,) and of buoys at the mouth of the Kennebec river, Maine, required by the act of March 3d, 1851, and the instructions of the department, has been made, and to present the following as the result:

The localities have been carefully examined by Lieutenant Commanding Maxwell Woodhull, who has presented all the information necessary to a correct conclusion in regard to the matters.

1. I agree with him in recommending a light-house on the southeastern point of Pond island, the light to be elevated not less than eighty feet above the line of high water, and to show a revolving light.

From Petit Menan island light, (on the outer seacoast,) Lieutenant Commanding Woodhull states: "The point of Pond island can be distinctly seen, the range bearing NNE., and gives the course to Pond island. After passing this point, a course due north takes the navigator directly to the mouth of the Narraguagus river, with the light always in sight if in deep water, but shut in if he encroaches too much on the ledges and middle ground, on either side of it."

The light should be erected near the southeastern extremity of the point. It should be, as recommended by Lieutenant Commanding Woodhull, of the class of smaller seacoast lights, (third order of lens lights,) elevated sufficiently to show three miles to the seaward of Petit Menan island light, and revolving, to distinguish it from the sea-coast lights on either side of it.

The intervals between the full brilliancy of the light and its disappearance should not be greater than a minute.

Lieutenant Commanding Woodhull gives the following facts as

bearing upon the usefulness of the light at Pond island, considered as a local light, to which class it essentially belongs:

"Besides the Narraguagus river, there are two others emptying into Narraguagus bay—Mill river, with the town of Huntingdon at its mouth, and East Marsh river. The trade of the towns of Cherryfield and Mill-bridge, on the Narraguagus river, is very large; last year they had 400 coasters and other vessels visit them, and receive cargoes. Their trade yearly amounts to 30,000,000 feet of sawed timber, with about 15,000,000 of manufactured lathes. For Huntingdon and "East Marsh," I have been informed, their trade is about half that amount. On these rivers, besides the lumber trade, a great number of vessels of various classes are built yearly."

2. I concur also with Lieutenant Commanding Woodhull in recommending that the buoys for White's and Thom's ledges, and Pond Island reef, at the mouth of the Kennebec, appropriated for in the act of March 3d, 1851, be immediately placed.

3. Lieutenant Commanding Woodhull further recommends a fog-whistle to be placed at the light-house at Petit Menan island, (off Narraguagus bay,) and at Monhegan island, (off Penobscot bay,) and remarks upon the inefficiency of the fog-bell at the latter place.

Also a buoy on Thomas' reef, near Thom's ledge, which he considers as imperfect as the other buoys reported upon, and which he states can, with the others, be placed for the sum appropriated for the three mentioned in the act.

"The trade of the different rivers that empty into Penobscot bay is conjointly estimated at about 3,000 vessels yearly, and an average of from three to four steamers daily, eight months of the year. Monhegan light is the entrance light to this bay."

In these recommendations I concur.

Lieutenant Commanding Woodhull states, that in the opinion of many intelligent navigators on this coast, the lights on "Goose island," (Penobscot bay,) and on Bear island, (Mount Desert,) should be discontinued, as not merely useless, but dangerous to navigation; in which opinion he concurs.

Very respectfully yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. W. L. HODGE,

Secretary of the Treasury.

APPENDIX No 20.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating, with his approval, the recommendation of Lieutenant Commanding M. Woodhull, United States navy, assistant in the coast survey, to place a light-boat on Shovelful shoals.

OSSIPEE STATION, NEAR ALFRED, MAINE,

September 1, 1851.

SIR: In compliance with the provisions of the act of March 3, 1851, and the instructions of the department, I have the honor to report that

the examination of the necessity for a light-boat at "Shovelful shoals," near Chatham, Massachusetts, has been made, and to recommend that a vessel of suitable size, and showing an effective light, should be placed on the southeast extremity of the shoal. I enclose herewith the report of Lieut. Commanding Maxwell Woodhull, United States navy, assistant coast survey, by whom this examination has been made, under my direction, and the sketch which accompanied it, illustrating the points referred to in the report.

Very respectfully yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

UNITED STATES SCHOONER MADISON,
Woods' Hole, August 24, 1851.

SIR: Agreeably to your order, I have examined all the particulars concerning the proposed light-boat on "Shovelful shoals," and am convinced, from my own observation and the opinions of the several pilots and masters of vessels with whom I have conferred on the subject, that a light-boat has long been needed on this shoal, and I therefore recommend its being placed there as soon as possible.

It should be placed on the southeast extremity of the shoal, that being the point where all the courses meet, whether coming from the *northward*, or from the north, middle, or southern channels of Vineyard sound. It would be a guide to clear the "Handkerchief," the "Stone Horse," and "Pollock Rip," and make the passage of "Butler's Hole" always serviceable, while it is now only useful in day-light. It would shorten the run to vessels making a harbor in the "Powder Hole" nineteen miles. If the weather is threatening and foggy, vessels now making the anchorage under the cape have to go round the "Pollock Rip" and the "Great Round Shoal," then run to the westward of the "Handkerchief," thereby lengthening the distance, and consequently increasing the danger; when, if the light-boat were on the "Shovelful," the passage between the shoals would be comparatively safe navigation.

I would recommend, in conjunction with this subject, as a new boat is to be built, and the appropriation is abundantly sufficient for the purpose, that it be of larger dimensions, of an improved construction, with a more powerful light, when ready, to be placed on "Pollock Rip," and the one now stationed there be transferred to the "Shovelful," where it would answer every purpose and be more useful than where it now is. The boat on "Pollock Rip" is too small for the purpose; it is a general complaint that during a blow the light cannot be hoisted sufficiently above the deck to be a certain guide, and in some instances could not be lighted, owing to the motion of the vessel throwing the oil from the lamps. I think a light-boat should be of sufficient capacity to carry the light at all times at the usual elevation, or it becomes of little or no service.

I send you a sketch of the locality, with the different shoals, placed agreeably to their relative positions, with the several *courses* laid down, showing where they converge, which will express the necessities of the case better than I can otherwise describe them.

Very respectfully,

MAXWELL WOODHULL,

Lieut. Commanding U. S. N., Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 21.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding C. H. McBlair, United States navy, assistant in the coast survey, on the erection of "bug" or harbor lights at Holmes' Hole, Martha's Vineyard.

COAST SURVEY STATION,

Near Portland, Maine, July 19, 1851.

SIR: I have the honor to report that the examination into the necessity for the erection of a light-house at Holmes' Hole, Martha's Vineyard, Massachusetts, has been made, as required by the act of Congress of March 3, 1851, and the instructions of the department. I communicate herewith the detailed report of Lieutenant Commanding Charles H. McBlair, United States navy, assistant in the coast survey, the officer by whom the examination was made under my direction.

I would further respectfully report, that, instead of the light-house at Holmes' Hole, for which an appropriation has been made, three small beacon-lights, technically known at that port as "bug lights," should be placed in the position shown on the accompanying Coast Survey chart, recommended by Lieutenant Commanding McBlair. For reasons stated in his report, these lights should be of the smallest class of *beacon-lights* used in harbors, on low wooden structures, the height being regulated by the elevation of the ground and the relation to surrounding objects. I would recommend that the light nearest the water should be red, and that all should be so screened as not to show, except on a moderately large sector, east side of the range line, which they are expected to give.

Three "bug lights," or beacons, can probably be put up within the appropriation made by the act of Congress; and it is a question for the department to decide, whether its authority extends to their immediate erection, or whether the subject must be referred to Congress, under the act of March 3d, 1851.

Very respectfully yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

U. S. SURVEYING STEAMER BIBB,
Nantucket Bar, July 16, 1851.

SIR: In obedience to your instructions, I have carefully examined Holmes' Hole harbor, for the purpose of ascertaining what additional lights are necessary, and the most suitable locations for them.

I would respectfully recommend the establishment of three harbor lights of the smallest class, to be placed on the sites indicated by the accompanying sketch. The houses might be frame structures, similar to those erected for the small lights called bug lights of this port. Buildings of this description would be most economical, and answer every purpose. They would be placed in such immediate vicinity to the village, that a dwelling for the keeper may not be necessary.

It is not important that the lights themselves should be visible over four miles. The greatest danger encountered in entering this harbor proceeds from the rocks and shoals lying near Low Point. The skirt of wood occupying the higher ground, at some distance from the beach, is sometimes mistaken at night for the shore line, leading vessels to double Low Point too closely to clear the shoal or rocks. Frequent disasters arise from this circumstance.

The lights placed as proposed, furnish two well-defined ranges, the object of one of which is to guard against this danger, while the other shows the mid-channel and best water along the entire harbor.

Holmes' Hole is used as a port of refuge by vessels navigating the sound, on occasion of head winds and tides and storms; and the adoption of these or similar improvements would add security to life and property.

If the lights suggested are established, it will be necessary to modify the present sailing directions. I have prepared the following, and present them to you in full at the present time, as the best means of exhibiting the value of the ranges referred to.

Entering this harbor from the westward, east chop well open with west chop light-house, clears you of the middle ground. Give west chop a berth of half a mile, until you bring on the western range of the harbor lights, when, with the chart for your guide, bear up for your anchorage in the outer roads. If you want to stand into the inner harbor, bring on the eastern range of the harbor lights, and follow it.

Approaching from the eastward, give east chop a berth of half a mile, and bring on the eastern range of the harbor lights; following which, you may cast anchor either in the outer or inner harbor.

Ships may anchor in three and a half fathoms, muddy bottom; west chop light just open, with woods on Low Point.

Small vessels may anchor immediately off the town.

You can beat in with safety, the shores being bold and clear. West chop light is fixed, elevated sixty feet above the level of the sea, and visible sixteen miles.

Respectfully,

C. H. McBLAIR,
Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Portland, Maine

APPENDIX No. 22.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation required by act of Congress and instructions of the Treasury Department.

COAST SURVEY OFFICE, April 29, 1851.

SIR: I have the honor to report upon the following objects referred to this office, embraced in the act of Congress making appropriations for light-houses, light-boats, beacons, and buoys, approved March 3, 1851:

No. 4. The eleven buoys in the channel to Commercial Point and Neponsett river, in Dorchester, are recommended, accompanied by a special report to me from Lieutenant Commanding Charles H. McBlair, United States navy, assistant coast survey, a copy of which accompanies this report, and a sketch showing a survey of the locality, from this office.

No. 6. A beacon on Fawn bar, near Deer island, is recommended. For detailed opinions see special report from Lieutenant Charles H. McBlair, United States navy, assistant coast survey; also with a sketch of the locality.

No. 7. The two iron spindles on the northeast ledge of the Graves, and on Harding's ledges, Boston harbor, are recommended. The special report of Lieutenant Charles H. McBlair, and accompanying sketch, may be referred to for detail.

No. 8. The proposed light-boat off Brenton's reef, Narragansett bay, is deemed of great importance. A sketch accompanies the special report of Lieutenant McBlair, which will show the proper position for it.

No. 14. The four spar-buoys for Fire Island inlet, Long Island, were recommended by this office, and are considered of the highest importance to the coasting trade of Great South bay.

No. 16. The light-house on Bodkin shoal, intended as a substitute for the one now on the Bodkin Point, is considered of much importance. A chart of the Patapsco river, with the proper position for the tower marked upon it, accompanies this report.

No. 19. The buoy for Middle Ground shoals, Beaufort harbor, North Carolina, was recommended by this office. Its proper position will be seen by reference to the accompanying sketch of Beaufort harbor.

Nos. 22 and 23. The buoy for Diamond shoal, Cape Hatteras, and the floating bell-beacon for the outer shoal, Cape Hatteras, were recommended by this office. The recommendation, accompanied by drawings and estimates, was submitted to the department for its approval.

No. 24. The light on the "Upper jettee," Cape Fear river, and the bridge leading to it, were understood, from a communication from the Fifth Auditor, to be included among the objects of appropriation referred to this office. A personal examination was made of the locality, which produced considerable doubt as to the necessity for the expenditure. Subsequent to the personal examination referred to, the Fifth Auditor advises me that this is one of the objects which he does not desire to

be examined by this office. It is deemed proper to say that it would be well to examine into this subject before the work is commenced.

No. 27. The light-houses authorized for Capes Disappointment and Flattery, and for New Dungeness, Oregon, have been recommended by this office, and are considered of the highest importance to the commerce of the northwest coast. The position on Cape Disappointment for the light will be marked in the Coast Survey chart of the Columbia river.

The light on New Dungeness should be placed near the extremity of the point, about $2\frac{1}{4}$ miles from the main land. As this is a very low point, not visible at night, it will require a tower of about eighty feet in height.

The light for Cape Flattery should be placed on Tatooche island, a small island almost touching the northwest extremity of Cape Flattery. The light is considered of great importance, as it will enable navigators to enter the straits at night, which they cannot do now.

The four spar-buoys for Fire Island inlet, the buoy for Middle Ground shoal, North Carolina, and the buoy and bell-beacon for Hatteras shoals, having been recommended by this office, I have to request authority to purchase by contract, under the regulations of the department, and place them in their respective positions. We can also conveniently place those in the Neponset river, if desired by the department.

An abstract of the subjects referred to this office, in this connexion, is herewith sent. The objects referred to this office, not reported upon, require personal examination, which is now being made. So soon as the reports are received, the department shall be informed of the result.

The sketches and special reports accompanying this are numbered according to the paragraphs in this letter referring to them. A general abstract showing all the objects for which appropriations have been made, and the disposition of the several subjects at this date, is herewith submitted.

Very respectfully, yours,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

Reports of Lieutenant Commanding McBlair, United States navy, assistant in coast survey, to the Superintendent, on certain aids to navigation in Boston harbor, &c.

COAST SURVEY OFFICE,

Washington, April 23, 1851.

SIR: I respectfully submit the following report, accompanied by sketches of the localities, on the subject of the improvements for the navigation of coast, referred to in your letter of instructions.

The objects proposed stand in the following order:

1. "Eleven buoys in the channel to Commercial Point and Neponset river, in Dorchester."
2. "A light-house at the head of Holmes' Hole harbor."

3. "A beacon on Fawn bar, near Deer island, Boston harbor."

4. "Two iron spindles on northeast ledge of the Graves and Harding's ledge, Boston harbor."

5. "A light-boat off Brenton's reef, Narragansett bay."

a. "Eleven buoys in the channel to Commercial Point and Neponsett river, in Dorchester."

A full report on this subject has been already laid before you in my letters of March 1, and February 22, 1851, copies of which I herewith enclose. It is only necessary to add that the buoys recommended have no other than local value.

b. "A light-house at the head of Holmes' Hole harbor."

Further examination, which can be conveniently made during the approaching season, will better enable me to report on this point.

c. "A beacon on Fawn bar, near Deer island, Boston harbor."

d. "Two iron spindles on the northeast ledge of the Graves and Harding's ledge, Boston harbor."

The northeast ledge of the Graves and Harding's ledge, as the outposts of the obstructions strewing the approaches to Boston, should be conspicuously marked, and spindles surmounted by cones of different colors would answer this purpose. Harding's ledge especially, now a danger in itself, and but imperfectly marked by a buoy, if distinguished by a spindle, would serve a valuable auxiliary guide in the approaches to the main ship channel.

The northeast ledge of the Graves, similarly marked, would answer the same end with respect to the neighboring Hypocrite and the Broad Sound channels.

In connexion with the spindle on the northeast Graves ledge, a beacon on Fawn bar would be serviceable as a good intervening mark between that ledge and the Deer Island beacon. Vessels using the Broad Sound and Hypocrite channels would thus be guided by a succession of distinct marks, each becoming visible in its turn before the one passed is entirely lost.

The particular advantage of a beacon on Fawn bar would be the facility it would give to the navigation of the Broad Sound north channel; the buoy now moored on the bar, to further this end, could then be advantageously shifted to the narrowest part of that channel on the western side.

e. "A light-boat off Brenton's reef, Narragansett bay."

The establishment of a light-boat here is of great importance. It would mark a dangerous shoal, and, in connexion with the Beaver Tail light, clearly define the entrance through the eastern channel into the harbor of Newport, Rhode Island.

I am of opinion that all the foregoing improvements would conduce largely to convenience and safety in the navigation of the respective waters where it is proposed to introduce them. Their value would be purely of a local kind, and they would have no other connexion with existing marks or lights than what has been pointed out.

Respectfully,

C. H. McBLAIR,
Assistant Coast Survey.

Professor A. D. BACHE.

COAST SURVEY OFFICE,

Washington, February 22, 1851.

DEAR SIR: From an examination of the chart showing the approaches to Dorchester, it would seem necessary for the safe navigation of those waters, which affects a large and increasing amount of tonnage, that eleven buoys, painted according to regulation, should be planted, viz: six to designate the channel to Commercial wharf, and the remaining five as guides to Neponset village. They must be distributed as follows: one on the west side of the channel opposite to Farm School, on Thompson's island, two on Cow Pasture bar, two on Term bar, and one opposite Commercial wharf.

The Neponset river would require one between Commercial wharf and Pine Neck, three along the curvature the river forms about Pine Neck, and one off the wharf at Neponset.

Respectfully,

C. H. McBLAIR,

Lieut. Commanding U. S. N., Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent Coast Survey.

COAST SURVEY OFFICE,

Washington, March 1, 1851.

SIR: Lieut. Com. Charles Davis, to whom was referred my letter respecting the buoying of the channel near Dorchester, suggests that the outer buoys spoken of in that communication should be of the usual harbor size, while the inner ones, and especially the river buoys, might be much smaller and less expensive.

I am, respectfully,

C. H. McBLAIR,

Lieut. Com. U. S. N., Assistant U. S. Coast Survey.

Prof. A. D. BACHE,

Superintendent Coast Survey.

APPENDIX No. 23.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, on ranges in New York harbor; with extracts from the report of assistant J. B. Gl ck.

COAST SURVEY OFFICE,

November 29, 1851.

SIR: An examination made of Flynn's Knoll, New York harbor, with the members of the Light-house Board, induced a doubt in my mind whether the light-house proposed to be erected there was the best aid to navigation which could be suggested; and, indeed, whether it might not alter injuriously the present régime of the harbor. The

inquiries of the Light-house Board were directed to the same points, and their conclusions will, therefore, also be before the department.

It occurred to me that a system of range-beacons could be used for passing Sandy Hook by the main ship channel, and for passing through the Swash channel, which would answer all the purposes of the proposed light on Flynn's Knoll, without being attended with any risk of causing new deposits on the bar, and which could be put up and maintained at a very small expense. I have accordingly caused minute surveys to be made of the shore near the probable sites of these beacons, and transmit, herewith, the sketches and report returned by assistant J. B. Glück, of the coast survey, and also a Coast Survey chart of New York bay and harbor, marking these and other sites on which range-lights may be established, to answer the purpose referred to above.

I would recommend two range-lights (beacon) to lead from the point G, in Gedney's channel, through the main ship channel, to the range of the beacons recommended in the sailing line H N through the Narrows; the beacons to be on the line G D or G M in the angle between them, as may be found most expedient, on an examination which should be made just previous to their location. The distance A D is rather small for the range, being less than one-ninth of G A. A beacon near L will furnish also other important ranges.

Also, two leading lights (beacon lights) for the Swash channel, nearly on the line S E. Before placing these lights the Swash channel should be carefully re-surveyed, which can be done at a very trifling expense by the Coast Survey, by using existing marks on the shore already determined in the survey, as there is an impression among the pilots that it is deepening. The beacons should be placed accordingly.

These lights should be so arranged that they will appear nearly in one when heading on the sailing lines. They should be distant from each other not less than about one mile and a half, or one-sixth of the distance from which they are first required to give the range. They should be carefully screened, so as only to show a light on the range or ranges which they are to indicate; and for distinction from each other, as they are only required to show some nine miles, the one near the Elm-tree beacon may be a red light, (deep red.)

Yours, respectfully,

A. D. BACHE,

Superintendent United States Coast Survey.

HON. THOMAS CORWIN,

Secretary of the Treasury.

Extracts from a report on ranges in New York bay, to Superintendent, by J. B. Glück, esq., assistant in coast survey.

UNITED STATES REVENUE CUTTER TANEY,

Brooklyn, New York, July 13, 1851.

DEAR SIR: I have just returned from surveying the two ranges for entering Swash and main channels of New York bay, in accordance with your instructions of July 1.

The range for entering Swash channel, of which Elm-tree beacon forms one part, affords unusual facilities, as it strikes over the narrow brows of three elevations of one and a half, ($1\frac{1}{2}$) one and three-quarters, ($1\frac{3}{4}$) and two miles distance from the beacon; being, respectively, sixty, (60) eighty, (80) and one hundred and sixty, (160) feet high. That of sixty is bare; that of eighty is covered with trees and thick brushwood from twenty to twenty-five feet high; and the one of one hundred and sixty with forest trees from sixty to seventy-five feet high. These three sites are upon the estate of Mr. George Ebbitt, New Dorp, Staten Island.

The range for coming through main ship channel touches the shore nearly a mile eastward of Point Comfort, through a very depressed part of the beach; the sand-banks on either side (from ten to twelve feet high) sinking nearly to the level of high-water mark. About three hundred metres back from the beach, the range strikes a swamp thickly covered with trees from fifteen to forty feet high; from thence it runs mostly through woodlands—occasionally through settlements and clearings. About a mile inland from the beach, the range crosses the creek and marsh making into the westward of Point Comfort. Upon the whole line surveyed there is no point that reaches an elevation of twenty feet, and, as I am informed, there is none for five miles further back, to the hills near Middletown. From the terminus of my survey, I could see back nearly another mile, but no higher elevation on that extension could be gained; I therefore confined the survey to the limits formed by the creek, on the banks of which the hills are slightly the highest. On this range both lights could be screened by trees, so as to be invisible to seaward, except on the range itself.

I am much indebted to Captain Rudolph, commanding United States revenue schooner Taney, and his officers, for their kindness in aiding the survey, and extending every facility possible for its accomplishment.

* * * * *

I send herewith the maps of New York bay, upon which I have marked the two ranges as directed.

The front light on Point Comfort range, for coming through main channel, might be placed at either A or B. The light would probably be sufficiently screened at A from being seen at sea, by the clump of trees about one hundred metres to the southeast, or by the woods on Sandy Hook, until the vessel is on the range itself. At B this purpose would be fully achieved.

The back light on this range might be properly placed at either C or D. The ground at D is several feet higher than at C, and therefore preferable. But little cutting is required to clear this whole range.

On the range for entering through Swash channel, where Elm-tree beacon now stands, will be the place for the front light. The break-water should be moved to the west of the beacon instead of to the eastward, as this structure, in its present position, only serves to undermine the beacon, for the protection of which it was built. Complaints are made in regard to the color, which is red; at a distance of about two miles off shore I found it to be scarcely visible.

There are four points on this range where the back light might be

located, although C is, in my opinion, the most desirable site for it, being on an elevation of eighty feet, covered with trees and bushes, high enough to screen the light from either side. The sites A and B are bare, and, respectively, twenty and sixty feet high. That at D is from one hundred and forty to one hundred and sixty feet high. The thick and almost inaccessible forest makes it difficult to give a true delineation of the ground, or an accurate value of its elevation.

A black and white flag is fastened to the highest tree on the range, and the tree determined.

Trusting that I have executed this work to your satisfaction, I am, most respectfully, your obedient servant,

JOHN B. GLUCK,
Assistant in Coast Survey.

Prof. A. D. BACHE, LL. D.,
*Superintendent United States Coast Survey,
Mount Pleasant, Maine.*

APPENDIX No. 24.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending certain aids to navigation on the coast of New York and New Jersey, required by act of Congress and instructions of the Treasury Department, and communicating the report of Lieutenants Commanding Jenkins and Woodhull, U. S. N., upon the same.

COAST SURVEY OFFICE,
June 13, 1851.

SIR: In compliance with the act of Congress of March 3, 1851, and with the instructions of the department of April 2d, I have the honor to report on the buoys, beacons, fog-bell, and light-house, numbered 9, 11, 12, 13, 17, 18, in the tabular statement of light-houses, beacons, and buoys, for which appropriations were made in the act just referred to. A copy of the tabular statement is annexed, with the additional remarks now submitted. The details of the recommendations are given in the report of Lieutenants Commanding Jenkins and Woodhull, herewith submitted, and the localities are marked in the Coast Survey charts A, B¹, B², C, D, and E, hereto appended.

No. 9. The buoy on Peafield reef, off Black Rock harbor, is recommended; also an additional buoy, for which, however, no appropriation has yet been made.

No. 11. The light-house on the north point of Gardiner's island is recommended, showing a red light. For the consideration inducing this recommendation, I refer to the report of Lieutenants Commanding Jenkins and Woodhull.

No. 12. The beacon in Sag harbor is recommended.

No. 13. The two beacons near Fort Hamilton are recommended. It is understood from the Chief Engineer, General Totten, that there will be no objection made to a temporary structure on the glacis of the redoubt of Fort Hamilton, in the locality marked on the chart.

No. 17. A fog-bell for Newark light-house is recommended.

No. 18. The four buoys in the Passaic river, and the one on Mill Rock, were found by the officers sent to make examination, to have been already placed, under authority from the Fifth Auditor.

b. The beacon recommended to be constructed, and the buoy now occupying its site should be removed to the three-feet sand-knoll south and east of Newark light.

c. The beacon at the corner stake, near Elizabeth Point, is recommended. For details relating to its construction, I refer to the report of Lieutenants Commanding Jenkins and Woodhull, herewith submitted.

Very respectfully, yours, &c.,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

Report of Lieutenants Commanding Jenkins and Woodhull, U. S. N., and assistants in coast survey, to the Superintendent, upon the necessity for placing certain aids to navigation, required by act of Congress and instructions of the Treasury Department.

U. S. SURVEYING SCHOONER MADISON,

Sag Harbor, May 14, 1851.

SIR: In compliance with your instructions of the 29th instant, we made a careful personal examination of the places enumerated, with reference to placing the proposed aids to navigation, in conformity to the 3d section of the act making appropriations for light-houses, light-boats, beacons, and buoys, approved March 3d, 1851, and submit the following report:

Two buoys should be placed on Peafield reef, off Black Rock harbor, as marked on the accompanying harbor chart. We recommend that the one authorized by law be placed on the S. (+) point of the shoal.

The contiguity of Plumb island and Little Gull island lights to the north point of Gardiner's island rendered the necessity for a light at that place somewhat doubtful; but upon a careful consideration and examination of the subject, we are satisfied it will be a very important aid to navigation. For coasters bound to Sag Harbor, Green Port, and other places in the vicinity from the eastward, it is very necessary, owing to the great length and little elevation of the point. To vessels from over-sea voyages it is important to guide them into a safe and commodious harbor of refuge. The tower should be placed as near the extremity of the north point as may be practicable, with reference to a good foundation, and the light should differ from the two nearest to it—(Plumb island and Little Gull island.) A bright red light would probably be the most suitable for the purpose.

We recommend that the beacon authorized to be placed in Sag harbor may be erected on the shoalest part of the southwest point of the sand-spit. We consider this beacon an important aid to the navigation of Sag

harbor, and that it should be constructed with sufficient stability to resist the ice when it breaks up in the spring.

The two beacons to be placed near Fort Hamilton are important: they should be placed upon the continuation of the sailing line, as represented on the Coast Survey chart, from near southwest spit up mid channel, to serve as leading marks by night as well as by day. The southern beacon should be placed near the fish-house, and the northern one near the redoubt. It is believed that a proper position may be found for the northern one on the public land, without interfering with other interests. One keeper could attend to these two beacons, provided his dwelling is placed contiguous to them. (See Coast Survey chart accompanying this report.)

A fog-bell is necessary for the Newark light-house.

A buoy on Mill Rock, (Constable's Point,) and four buoys to mark the channel of the Passaic, have been found already placed. The accompanying Coast Survey chart will exhibit the approximate positions of the buoys. The can-buoy on this sketch is a short distance to the eastward of the position for the beacon authorized to be erected, which we consider to be important, and recommend that it be built on three wooden piles, driven at the angles of a triangle, with the proper inclination to form a pyramidal structure when boarded up.

We recommend that the buoy now occupying the position of the beacon may be placed on the three-feet sand-knoll, to the southward and eastward of the Newark light, when the beacon shall be completed.

The proposed beacon to be placed at the corner stake, near Elizabethtown Point, is an important and very necessary aid to navigation. We recommend that it should be built in the same manner described for the one at the mouth of the Passaic.

The piles for this and the Passaic beacon should be coppered a sufficient distance above and below the water, to prevent the ice from injuring them; any solid structure would injure the channels.

Very respectfully, yours,

THORNTON A. JENKINS,

Lieutenant U. S. Navy, Assistant U. S. Coast Survey.

M. WOODHULL,

Lieut. Com. U. S. Navy, Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 25.

Report of Sears C. Walker, assistant in the coast survey, communicating the measures of wave-time made from 1849 to 1851.

CAMBRIDGE, September 30, 1851.

DEAR SIR: I beg to submit a statement of the experience of the Coast Survey on the subject of galvanic wave-time, since my last annual report of October 15th, 1850.

The result of our experience was then stated, as follows:

1. That the average of all our experiments to that time indicates a velocity of propagation of the inducing waves of 15,400 miles per second in the iron wires of a telegraph line.

2. That the velocity of propagation through the ground appears to be less than two-thirds of the velocity in the iron wires.

These conclusions were in accordance with the independent results of the researches of Dr. B. A. Gould and Mr. Karl Culman, previously read, and since published in the proceedings of the American Association for the Advancement of Science, at their meeting at New Haven, in August, 1850.

There have been three independent series of observations for the value of wave-time, made since October last, 1850.

The first experiment was repeated on several nights, between Seaton station and Portsmouth, Va. The distance on the iron wires is 268 miles, and the distance through the ground is 180 miles. The clock station excess, in the electrotonic readings, by a mean of 221 measures, was $+0s.024$, while the computed excess for the assumed velocity of 15,400 miles per second, in the iron wires, was $+0s.035$. The difference between theory and computation is, theory greater by $+0s.011$.

The second experiment was made from Charleston, S. C., to Augusta, Ga., in the winter of 1851. The distance on the iron wire from Columbia (where the Charleston end went to the ground) to Augusta, was 301 miles, and from Augusta to Savannah 146 miles—making the total connexion through the iron wire 447 miles, and the distance through the ground, from Columbia to Savannah, 135 miles. The clock was at Savannah. The arbitrary signals were given at Charleston. The observed clock excess was by 59 measures $+0s.056$. The computed wave-time, for the above assumed velocity, was $+0s.058$, leaving a difference of $+0s.002$.

The clock excess of Augusta above Savannah was, by observation, (forty measures,) $+0s.019$; by theory, $+0s.019$; difference $+0s.000$.

The third experiment was made at Cincinnati, on the 9th of May last, on the occasion of the meeting of the American Association for the Advancement of Science. The telegraph line was composed of 840 miles of iron wire, without ground connexion. The distances were as follows: From Cincinnati to Steubenville 295 miles; thence to Cincinnati the same; thence to Louisville 125 miles; thence to Cincinnati the same. The personal clock signals were given by Mr. Stager, chief operator at Cincinnati. In the first experiment the arbitrary signals were given by the operator at Steubenville, and recorded at Steubenville, and also on the two registers at Cincinnati, on opposite branches of the line. These registers I will call, respectively, Stager and Jones; Stager being the register for the clock station. The observed excesses were, for the Steubenville arbitrary signals, as follows:

Stager—Steubenville.....	$+0s.040$ by 31 measures.
Stager—Jones	$+0s.039$ by 31 “

Again, for the Jones arbitrary signals, on the Stager clock scale, we found:

Stager—Steubenville.....	$-0s.004$ by 39 measures.
Stager—Jones	$+0s.050$ by 226 “

harbor, and that it should be constructed with sufficient stability to resist the ice when it breaks up in the spring.

The two beacons to be placed near Fort Hamilton are important: they should be placed upon the continuation of the sailing line, as represented on the Coast Survey chart, from near southwest spit up mid channel, to serve as leading marks by night as well as by day. The southern beacon should be placed near the fish-house, and the northern one near the redoubt. It is believed that a proper position may be found for the northern one on the public land, without interfering with other interests. One keeper could attend to these two beacons, provided his dwelling is placed contiguous to them. (See Coast Survey chart accompanying this report.)

A fog-bell is necessary for the Newark light-house.

A buoy on Mill Rock, (Constable's Point,) and four buoys to mark the channel of the Passaic, have been found already placed. The accompanying Coast Survey chart will exhibit the approximate positions of the buoys. The can-buoy on this sketch is a short distance to the eastward of the position for the beacon authorized to be erected, which we consider to be important, and recommend that it be built on three wooden piles, driven at the angles of a triangle, with the proper inclination to form a pyramidal structure when boarded up.

We recommend that the buoy now occupying the position of the beacon may be placed on the three-feet sand-knoll, to the southward and eastward of the Newark light, when the beacon shall be completed.

The proposed beacon to be placed at the corner stake, near Elizabethtown Point, is an important and very necessary aid to navigation. We recommend that it should be built in the same manner described for the one at the mouth of the Passaic.

The piles for this and the Passaic beacon should be coppered a sufficient distance above and below the water, to prevent the ice from injuring them; any solid structure would injure the channels.

Very respectfully, yours,

THORNTON A. JENKINS,

Lieutenant U. S. Navy, Assistant U. S. Coast Survey.

M. WOODHULL,

Lieut. Com. U. S. Navy, Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 25.

Report of Sears C. Walker, assistant in the coast survey, communicating the measures of wave-time made from 1849 to 1851.

CAMBRIDGE, September 30, 1851.

DEAR SIR: I beg to submit a statement of the experience of the Coast Survey on the subject of galvanic wave-time, since my last annual report of October 15th, 1850.

The result of our experience was then stated, as follows:

1. That the average of all our experiments to that time indicates a velocity of propagation of the inducing waves of 15,400 miles per second in the iron wires of a telegraph line.

2. That the velocity of propagation through the ground appears to be less than two-thirds of the velocity in the iron wires.

These conclusions were in accordance with the independent results of the researches of Dr. B. A. Gould and Mr. Karl Culman, previously read, and since published in the proceedings of the American Association for the Advancement of Science, at their meeting at New Haven, in August, 1850.

There have been three independent series of observations for the value of wave-time, made since October last, 1850.

The first experiment was repeated on several nights, between Seaton station and Portsmouth, Va. The distance on the iron wires is 268 miles, and the distance through the ground is 180 miles. The clock station excess, in the electrotonic readings, by a mean of 221 measures, was $+0s.024$, while the computed excess for the assumed velocity of 15,400 miles per second, in the iron wires, was $+0s.035$. The difference between theory and computation is, theory greater by $+0s.011$.

The second experiment was made from Charleston, S. C., to Augusta, Ga., in the winter of 1851. The distance on the iron wire from Columbia (where the Charleston end went to the ground) to Augusta, was 301 miles, and from Augusta to Savannah 146 miles—making the total connexion through the iron wire 447 miles, and the distance through the ground, from Columbia to Savannah, 135 miles. The clock was at Savannah. The arbitrary signals were given at Charleston. The observed clock excess was by 59 measures $+0s.056$. The computed wave-time, for the above assumed velocity, was $+0s.058$, leaving a difference of $+0s.002$.

The clock excess of Augusta above Savannah was, by observation, (forty measures,) $+0s.019$; by theory, $+0s.019$; difference $+0s.000$.

The third experiment was made at Cincinnati, on the 9th of May last, on the occasion of the meeting of the American Association for the Advancement of Science. The telegraph line was composed of 840 miles of iron wire, without ground connexion. The distances were as follows: From Cincinnati to Steubenville 295 miles; thence to Cincinnati the same; thence to Louisville 125 miles; thence to Cincinnati the same. The personal clock signals were given by Mr. Stager, chief operator at Cincinnati. In the first experiment the arbitrary signals were given by the operator at Steubenville, and recorded at Steubenville, and also on the two registers at Cincinnati, on opposite branches of the line. These registers I will call, respectively, Stager and Jones; Stager being the register for the clock station. The observed excesses were, for the Steubenville arbitrary signals, as follows:

Stager—Steubenville.....	$+0s.040$ by 31 measures.
Stager—Jones	$+0s.039$ by 31 “

Again, for the Jones arbitrary signals, on the Stager clock scale, we found:

Stager—Steubenville.....	$-0s.004$ by 39 measures.
Stager—Jones	$+0s.050$ by 226 “

The direction of the current from the platinum to the zinc, through the junction wires, was from Stager to Steubenville; thence to Jones; thence round by Louisville to Stager.

This is the first experiment made by the Coast Survey on a telegraph line of iron wire exclusively, without ground connexion.

The first conclusion to be drawn from this experiment is, that the excesses of the clock station readings, in the experiments heretofore made, have not been owing to the fact that a part of the galvanic circuit has been made through the ground, since they are here found to be as great for the dimensions of the line as in former experiments, with the partial ground connexions.

This experiment was made with a long circuit of iron wire, without ground connexion. It confirms the general conclusion respecting the value of wave-time.

It gives a new field for the discussion of the physical question whether the wave is propagated round in one direction, and only affects the magnets as it reaches them in succession in this direction, or whether the wave travels by the *shortest* direction from one magnet to another, without reference to the character of the poles.

Our experiments with lines composed partly of ground and partly of iron wire stretched on poles, led to the preference of the latter view of the subject.

The experiment at Cincinnati, in 1851, raises some doubt on this conclusion. It was made with a single battery at Cincinnati, and with 840 miles of wire, all in the air. The work of this night was not as complete as I could have desired. I must, therefore, wait till similar experiments are made, under more favorable circumstances, before attempting a further examination of the question.

No.	Date.	Clock station.	Signal station.	Name of excess.	Miles of wave space.	Observed wave time.	No. of measures.	Obs'd—comp'd wave time.
						s.		s.
1	January 23, 1849	Pa ..	Ca...	Pa—Ca	938	+0.063	25	+0.002
2	do do do	do ..	do ..	do—N	418	.024	16	+0.003
3	do do do	do ..	do ..	Wn—Ca	938	.053	34	+0.008
4	do do do	do ..	do ..	do—N	418	.011	23	+0.016
5	do do do	do ..	do ..	N—Ca	520	.039	18	—0.005
6	do do do	do ..	N ..	Pa—N	418	.036	7	—0.009
7	do do do	do ..	do ..	do—Ca	418	.004	8	+0.023
8	do do do	do ..	do ..	Wn—Ca	418	.034	9	—0.007
9	do do do	do ..	do ..	Wn—N	418	.020	14	+0.007
10	October 31 1849	Ci...	Wn..	Ci—Wn.....	1, 151	.068	88	—0.008
11	do do do	do ..	do ..	do—Cd	651	.043	12	—0.001
12	do do do	Wn..	Cd ..	Wn—Ci.....	330	.019	34	—0.002
13	do do do	do ..	do ..	do—Ci	330	.023	29	+0.002
14	do do do	do ..	do ..	H—Cd	182	.008	22	+0.004
15	do do do	do ..	do ..	do—Ci	182	.009	25	+0.003
16	do do do	do ..	Wg..	Wn—Cd	330	.017	17	+0.004
17	do do do	do ..	do ..	do—Ci	618	.025	12	+0.015
18	do do do	do ..	do ..	H—Cd	182	.038	5	—0.026
19	do do do	do ..	do ..	do—Ci	470	.043	9	—0.013
20	do do do	do ..	do ..	Cd—Ci	288	.004	12	+0.015
21	February 4, 1850	do ..	Pg ..	Wn—Pg	576	.028	41	+0.009
22	do do do	do ..	do ..	do—do	576	.030	44	+0.007
23	do do do	do ..	do ..	do—Ci	576	.034	33	+0.003
24	do do do	do ..	do ..	do—do	576	.032	36	+0.005
25	do do do	do ..	do ..	do—L	576	.035	57	+0.002
26	do do do	do ..	do ..	do—S. L....	576	.051	11	—0.014
27	do do do	do ..	Ci...	do—Pg	576	.028	32	+0.009
28	do do do	do ..	Le ..	do—do	576	.028	47	+0.009
29	do do do	do ..	Ls ..	do—do	576	.045	56	—0.008
30	do do do	do ..	Ci...	do—Ci	1, 244	.075	33	+0.004
31	do do do	do ..	do ..	do—Le	1, 244	.075	32	+0.004
32	do do do	do ..	do ..	do—Ls	1, 244	.070	26	+0.014
33	do do do	do ..	Le ..	do—Ci	1, 244	.081	58	+0.001
34	do do do	do ..	Ls ..	do—Ci	1, 244	.095	60	—0.016
35	do do do	do ..	Le ..	do—Le	1, 494	.109	56	—0.013
36	do do do	do ..	do ..	do—Ls	1, 494	.102	49	—0.006
37	do do do	do ..	Ls ..	do—Le	1, 494	.134	65	—0.038
38	do do do	do ..	do ..	do—Ls	2, 090	.145	61	—0.049
39	do do do	do ..	Ci...	Pg—Ci	668	.047	32	—0.004
40	do do do	do ..	do ..	do—Le	668	.047	32	—0.004
41	do do do	do ..	do ..	do—Ls	668	.042	29	+0.001
42	do do do	do ..	Le ..	do—Le	918	.081	48	—0.023
43	do do do	do ..	do ..	do—Ls	918	.074	58	—0.016
44	do do do	do ..	Ls ..	do—do	1, 514	.089	60	+0.008
45	do do do	do ..	do ..	Ci—do	846	.050	60	0.005
46	do do do	do ..	do ..	Le—do	596	.032	57	+0.006
47	February 5, 1850	do ..	Cn ..	Wn—Cn	1, 416	.084	45	—0.008
48	July 8	Bn ..	N ..	Bn—N	484	.033	63	—0.002
49	December	Sn...	Ps...	Sn—Ps	536	.024	221	+0.011
50	Feb. and March..	Sa...	Cn ..	Sa—Cn	596	.056	59	+0.017
51	do do do	do ..	Aa ..	Sa—Aa	292	.019	40	+0.000
52	May 9, 1851	Ci...	Se...	Ci—Se	580	.040	31	+0.006
					38, 294	+2.496	2, 051	

From which it appears that the time of traversing 15,342 miles is one second. The column marked (obs'd—comp'd) is based upon this value.

Yours, respectfully,

SEARS C. WALKER, Assistant C. S.

APPENDIX No. 26.

Abstract of reports on longitudes, by Sears C. Walker, assistant in the coast survey, to the Superintendent.

CAMBRIDGE, September 30, 1851.

DEAR SIR: I beg to submit an abstract of all my reports on longitude hitherto made.

Harvard Observatory, west of Greenwich.

	<i>h.</i>	<i>m.</i>	<i>s.</i>
(A) By moon-culminations at Harvard, 1843-1845.....	4	44	28.47
“ “ “ “ Hudson, Ohio, 1838-1844..			28.62
“ “ “ “ Wilkes' obs'y, 1838-1842...			28.52
“ “ “ “ Washington obs'y, 1845....			28.06

(A) Mean by moon-culminations.....	4	44	28.42
------------------------------------	---	----	-------

(B) By eclipses, transits, and occultations—

				<i>Weight.</i>
“ At Dorchester and Harvard, 1820-1840.....	4	44	32.16	— 6.4
“ “ Brooklyn, New York.....			31.22	— 0.4
“ “ Philadelphia, 1769-1840.....			32.56	— 2.5
“ “ Wilkes' observatory, 1838-1842.....			33.13	— 1.0

“ “ Mean by eclipses, transits, and occultations..	4	44	32.27	—10.3
--	---	----	-------	-------

These phenomena have been reduced by Burkhardt's tables, and include, on the average, the constant error of his parallax of the moon. Airy, in his reductions of the Greenwich observations of the moon, makes the correction of this parallax to be $\Delta \pi_0 = +1''.78$. Professor Peirce and myself have computed the average value of the coefficient $\left(\frac{\Delta d}{\Delta \pi}\right) = -1s.5$, whence $\left(\frac{\Delta d}{\Delta \pi}\right) \times \Delta \pi_0 = -2s.67$; and $4h. 44m. 32s.27 - 2s. 67$ are—

	<i>h.</i>	<i>m.</i>	<i>s.</i>
(B') Corrected mean by eclipses, transits, and occultations	4	44	29.60

(C) By chronometers with Liverpool—

Indiscriminate mean of 373 chronometers in all....	4	44	30.92
“ “ 175 “ { Great special }			30.96
“ “ “ “ { Exp. of 1849 }			
Bond's “ “ “ “ “			30.10

(C) Adopting the last value.....	4	44	30.10
----------------------------------	---	----	-------

(A) Longitude of Harvard observatory	4	44	28.42
--	---	----	-------

(B') “ “ “ “			29.64
--------------------	--	--	-------

(C) “ “ “ “			30.10
-------------------	--	--	-------

Adopted for the present, Harvard observatory	4	44	29.05
--	---	----	-------

Then we have, by the telegraph operations of the Coast Survey, the following results from Greenwich, depending on this assumed longitude of Harvard observatory :

	<i>h.</i>	<i>m.</i>	<i>s.</i>
New York, (City Hall,).....	4	56	00.150
Philadelphia observatory.....	5	00	37.504
Seaton Station, (Washington, D. C.).....	5	07	58.564
Capitol, Washington.....	5	08	00.853
Wilkes' observatory.....	5	08	00.958
Washington observatory.....	5	08	11.206
Georgetown observatory (Georgetown, D. C.).....	5	08	17.206
Charleston observatory, S. C. (Sec. V).....	5	19	43.832
Savannah Exchange, (Sec. V).....	5	24	20.572
Hudson observatory, Ohio,.....	5	25	43.205
Cincinnati observatory.....	5	37	58.062

The following results depend on moon culminations and occultations :

Sand Key, Florida, (Sec. VI).....	5	27	31.641
Moro Castle, (Havana).....	5	29	24.000
Point Conception, (Sec. X).....	8	01	42.640

Respectfully submitted :

SEARS C. WALKER, *Assistant Coast Survey.*

Prof. A. D. BACHE, LL. D.,

Superintendent Coast Survey.

APPENDIX No. 27.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Fishing Battery, in Chesapeake bay; and report of examination by Lieutenant Commanding J. J. Almy, United States navy, assistant in the coast survey.

COAST SURVEY OFFICE, November 20, 1851.

SIR: I have the honor to report that an examination has been made, as required by the act of Congress approved March 3, 1851, by the instructions of the department, of the necessity for a light-house at Fishing Battery, otherwise called Donahoo's Battery, in the Chesapeake, near Havre-de-Grace, Maryland, and to recommend the construction of a tower there of fifteen feet in height, to show a light of the fourth order, or harbor light. The position proposed for a light-house is marked in the accompanying tracing from the Coast Survey map of Chesapeake bay. The details of the examination made by Lieutenant Commanding Almy, United States navy, assistant in the coast survey, are given in the report which is herewith transmitted, which also states in detail the purposes to be answered by the light, and its relations to the lights already established in the vicinity at Havre-de-Grace, and at Turkey Point.

Very respectfully yours,

A. D. BACHE, *Superintendent U. S. Coast Survey.*

Hon. THOS. CORWIN, *Secretary of the Treasury.*

WASHINGTON CITY,
November 18, 1851.

SIR: In obedience to your instructions, I have made an examination of Fishing Battery, Chesapeake bay, with reference to placing the proposed light-house for which an appropriation was made at the last session of Congress.

Fishing Battery (sometimes called Donahoo's Battery) lies S. $\frac{1}{4}$ E., (true,) distant three miles from Havre-de-Grace light-house, and NW. $\frac{3}{4}$ W. (true,) distant five and a half miles from Turkey Point light-house. It is upon the edge, on the southwest side of the extensive flats off and abreast the mouth of the Susquehanna river. The channel for loaded vessels leaving Havre-de-Grace for Baltimore, runs by and within half a mile of Fishing Battery, and when abreast of it, vessels have to change their course at right-angles; therefore I unhesitatingly say, that for vessels running at night I consider it necessary to have a light here.

The kind of light which, in my judgment, would best answer and subserve all necessary purposes, would be a beacon light—a fixed dark red light, elevated about fifteen feet above the surface of the water. Owing to its relative position to Havre-de-Grace light and Turkey Point light, the light to be placed upon Fishing Battery would not require to be seen a distance exceeding five miles. I recommend a fixed dark red light, because both Turkey Point light and Havre-de-Grace light are fixed lights of a whitish color.

Fishing Battery has piles already driven, partially planked over, and there are sheds and buildings of a rough, rude structure, for the accommodation of fishing operations. I cannot speak with certainty as to whether these piles are driven firmly enough into the ground, or whether they are in a sufficiently sound condition for a foundation upon which to erect a structure for a light. To ascertain this, the planking will have to be taken up, and an examination made by a person thoroughly versed in such matters.

I am, sir, respectfully yours,

JOHN J. ALMY,

Lieutenant U. S. Navy, Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent Coast Survey.

APPENDIX No. 28.

Extracts from the report of Henry L. Whiting, Esq., assistant in the coast survey, to the Superintendent, on the survey of Beaufort, North Carolina.

WASHINGTON, May 13, 1851.

DEAR SIR: * * * * *

The survey is extended, on the outside shore, about three miles from either point of the inlet, and beyond the limits of the bar and shoals of its entrance. In the harbor and about the town, I have carried the survey *beyond* all the important localities, so as to fully *include* all the channel-ways connecting the harbor with the interior waters, and furnishing

topographical detail to show the approaches by land to the best water and landings, with the character of the shore, which is of course represented in our conventional signs.

I have also made as accurate a survey as their character will admit, of the shoals and bars within the harbor, as they exist at low water of ordinary spring tides.

* * * * *

In reporting upon the natural character and peculiarities of Beaufort, as a harbor and port, I will state such facts as have come under my personal knowledge, and also communicate my opinion regarding its entrance and the facilities it might afford to the commercial interest of this region.

The outside beach, or "bank," opposite Beaufort harbor, is of the usual formation of this coast. It is mostly covered with a low pine, and mixed growth, and its average width is about half a mile; the sand hills and ridges upon it are from 20 to 35 or 40 feet high, thus forming a good and sufficient shelter, from both wind and sea, to all vessels anchored inside the banks; the holding-ground is also good, as shown by the results of the hydrographical survey.

The interior shores of the harbor are mostly of marsh, grown with masses of oyster-beds and shells, which, near the edges and where the sand has united with them, are quite hard and solid. At Lenoxville and Shepherd's Point, and at the town of Beaufort, the main upland comes to the water's edge. At the two former points, the deep waters of Newport and North River channels approach quite near the shore, and without any intervening shoals.

During the last thirty years there does not appear to have been any particular change, either in the shore-line or shoals *within* the limits of the harbor. The causes and action of tide, &c., which first formed them, seem to continue them in their general position and extent.

That the inlet and bar of Beaufort are probably the best on our whole eastern seacoast, south of the Chesapeake bay, is, I believe, a matter of fact, and needs no comment.

There are two principal causes which, I think, have preserved this inlet, and will continue to keep it open, with probably deeper water than any of the other harbors on this coast.

One of these causes is the shelter and eddy currents occasioned by Cape Lookout. The influence of these currents upon the inlet, opening as it does to the south, and in the "bite" of the cove immediately under it, is, to cut and carry away the sands and shoals which storms may throw up, and deposit them at the point of the cape. At least, it is obvious that the influence which has formed Cape Lookout, and creates the deep water and bold shore of this cove immediately south of it, will not allow any deposits to take place at a point where the eddy and counter-currents have their greatest effect; while the projection of the cape, and the shoals extending beyond it, prevent the action of the sea within this cove from being as great, or having the same effect, as upon a coast presenting an unprotected and nearly even outline to the action of storms and breakers, as is the case on the shores both above and below Cape Lookout and Cape Hatteras.

The other influence which I think will always tend to preserve the inlet at Beaufort, is from the non-existence of any large interior sound or bay.

The current through the inlet is wholly a tidal one, and the back waters of "Borgne" and "Cove sounds," and from "Newport" and "North" rivers, accumulate no more on the flood tide than escapes on the ebb; they are also of such extent and so located as to be materially affected by the tide, being filled and emptied by the flood and ebb, and there are no fresh-water feeders to either of the rivers sufficient to at all affect their currents.

There is thus a strong and continual tidal current through the inlet, and this current is not lost or overpowered by a heavy swell from sea, deadening its effect and throwing back the sand, which it displaces, in shoals and bars; but it runs with the eddy currents of the cove into which the inlet opens, and the same action and effect is continued that the current out of the inlet produces, all tending to preserve and deepen the channel.

In comparing the inlet at Beaufort with Ocracoke and others opening from the large sounds, the advantages and disadvantages of either are obvious. These latter are almost as much exposed on the inside to the great mass of waters in the sounds as they are on the outside to the ocean. The effect of storms and tides is consequently great as well as uncertain. Heavy storms from the westward prevent the tide from flowing through the inlets from the ocean, while the water and surf from the sounds heave up swashes and shoals on the inside.

The action of storms from sea is still worse, while the waters of the sounds are driven back and shoals are thrown up and formed across the mouth of the inlet, without any counter influence to prevent or carry them away.

In a commercial point of view, Beaufort, as a harbor and port, has many advantages and is well situated. There is no river or inland navigation to delay or require the towing of large vessels. A ship drawing 20 feet water can leave at any state of the tide with almost any wind, and discharge her pilot *at sea* in from 30 to 45 minutes after weighing anchor.

It seems, therefore, that the usefulness of one of the best harbors and ports on our whole southern coast is lost from the want of proper facilities of communication and internal improvements, giving access to it from the interior country and cities.

* * * * *

I remain, sir, very respectfully yours,

HENRY L. WHITING.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 29.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieut. Com. J. N. Maffitt, U. S. N., assistant in the coast survey, upon the necessity for certain aids to navigation in Beaufort harbor, N. C.

COAST SURVEY OFFICE,
February 27, 1851.

SIR: I have the honor to transmit a report just received from Lieut. Com. J. N. Maffitt, U. S. N., assistant in the coast survey, of buoys and beacon (or range) lights, required in the harbor of Beaufort, North Carolina, the hydrography of which has been executed by the party under his command, and would respectfully request that it may, with the accompanying sketch showing the position of the beacons and lights, be transmitted to the authority which should act in the matter.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

Report of Lieutenant Commanding John N. Maffitt, U. S. N., assistant in the coast survey, to the Superintendent, in relation to lights and buoys in Beaufort harbor, N. C.

UNITED STATES SCHOONER GALLATIN,
North Edisto, S. C., February 8, 1851.

SIR: I respectfully propose the following improvements in the harbor of Beaufort, N. C., for the purpose of rendering it safe for a vessel to enter without a pilot, by day or night, viz:

1st. *A single bug-light* on Shackleford Point, due north of Bar buoy, (which should be brought to bear north and then run for, until the first range course is made.)

2d. *Two bug-lights* west of Fort Macon, to be placed in range for first course after passing the Bar buoy. (See sketch.)

3d. *Two bug-lights*—one on Macon Point, the other on the marsh in the rear—giving the range for course No. 2. (See sketch.)

4th. A buoy on 10-foot spot, and marked on the sketch *Buoy No. 2.*

5th. A buoy on the south spit of the middle ground, marked on sketch *Buoy No. 3.*

6th. A buoy in mouth of the Slue, marked on the sketch *Buoy No. 4.*

7th. A buoy on the west side of the middle ground, marked on the sketch *Buoy No. 5.*

With such guides a stranger could enter, by day or night, without fear.

Respectfully, &c.,

J. N. MAFFITT,
Lieut. Com., Assistant U. S. Coast Survey.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

APPENDIX No. 30.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, U. S. N., assistant in the coast survey, on the necessity for a light-house on the upper jettee, Cape Fear river, N. C.

CAPE SMALL POINT,
Near Bath, Maine, October, 15, 1851.

SIR: I have the honor to report, that in conformity with the act approved March 3, 1851, making appropriations for light-houses, buoys, &c., and the instructions of the department, the question of the necessity for a light-house on the upper jettee of Cape Fear river has been examined, and that I recommend the construction of the same, for the reason assigned in the report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

The report of Lieutenant Maffitt is herewith transmitted, with the "eye-sketch" which accompanied it.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

SMITHVILLE, N. C., September 12, 1851.

DEAR SIR: I have visited the "upper jetties of Cape Fear river," and herewith enclose to you an "eye-sketch" of that section, where some improvements are requisite for the benefit of navigation.

On the upper eastern jettee (No. 2) a light is certainly required, that steamers and sailing-vessels bound down at night may be enabled to keep the "fair channel way," which they cannot always do at present, from the fact, that as the field of view is opened from just above Graham's island, jettee No. 2 trenches entirely athwart the *apparent* channel, and there is no guide which will enable a mariner to calculate how to steer, in order to clear this jettee, and keep in the best water, which is close to its end. The same holds good (from the sudden bend of the river) in sailing up.

It is not an uncommon circumstance at night for vessels to misjudge their distance, and run into jettee No. 2. The upper western jettee is out of the channel way; a light there would be useless.

The "reaches" over "Wreck shoal" are not long enough to warrant the erection of "range lights."

I consider it necessary that the present buoys be *replaced* by *larger ones*; and as the forest on each side gives a dark back-ground, they should be painted *white*; they would then always be seen on a star-light night.

I also propose that "tripods," painted white, be erected on jetties Nos. 3, 4, and 6. They would materially assist the navigator in

avoiding the shoals, and *jetties themselves*, which are low in the water, dilapidated, and more dangerous to vessels than beneficial to the river.

* * * * *

A requisite light-house for the upper eastern jettee should not cost over four thousand dollars.

Very respectfully, your obedient servant,

J. N. MAFFITT,

Lieut. Com. and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 30, *bis.*

Letter from the President of the Chamber of Commerce of Charleston, S. C., to the Superintendent of the U. S. Coast Survey, requesting a tracing of the chart of Charleston harbor.

CHARLESTON, June 18, 1851.

DEAR SIR: At an extra meeting of the Chamber of Commerce of Charleston, held this day, the enclosed resolution was unanimously adopted, and I was instructed to transmit you a copy, and express the hope that you may be able conveniently to comply with our request.

We desired a copy of this chart to assist us in forming some opinion of the best method of improving the entrance to our harbor. Public attention has long been attracted to the "Sullivan's island" channel, as offering strong inducements to attempt some improvements there, and the developments made by the Coast Survey tend strongly to encourage this feeling. If you have had your attention attracted to this subject, and adopted any definite views in relation to it, you would be doing essential aid to a subject of vast public importance and profound interest to our community by making your opinions known.

Yours, with great respect,

G. W. TRENHOLM,

President Charleston Chamber of Commerce.

Prof. BACHE, *Washington.*

Resolved, That Professor Bache be respectfully requested to furnish the Chamber of Commerce, for the use of the mercantile and navigating interests of Charleston, a tracing of the chart of Charleston harbor, recently constructed under the direction of the Coast Survey.

APPENDIX No. 30.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a report of Lieutenant Commanding J. N. Maffitt, U. S. N., assistant in the coast survey, on the necessity for a light-house on the upper jettee, Cape Fear river, N. C.

CAPE SMALL POINT,
Near Bath, Maine, October, 15, 1851.

SIR: I have the honor to report, that in conformity with the act approved March 3, 1851, making appropriations for light-houses, buoys, &c., and the instructions of the department, the question of the necessity for a light-house on the upper jettee of Cape Fear river has been examined, and that I recommend the construction of the same, for the reason assigned in the report of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

The report of Lieutenant Maffitt is herewith transmitted, with the "eye-sketch" which accompanied it.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

HON. THOMAS CORWIN,
Secretary of the Treasury.

SMITHVILLE, N. C., September 12, 1851.

DEAR SIR: I have visited the "upper jetties of Cape Fear river," and herewith enclose to you an "eye-sketch" of that section, where some improvements are requisite for the benefit of navigation.

On the upper eastern jettee (No. 2) a light is certainly required, that steamers and sailing-vessels bound down at night may be enabled to keep the "fair channel way," which they cannot always do at present, from the fact, that as the field of view is opened from just above Graham's island, jettee No. 2 trenches entirely athwart the *apparent* channel, and there is no guide which will enable a mariner to calculate how to steer, in order to clear this jettee, and keep in the best water, which is close to its end. The same holds good (from the sudden bend of the river) in sailing up.

It is not an uncommon circumstance at night for vessels to misjudge their distance, and run into jettee No. 2. The upper western jettee is out of the channel way; a light there would be useless.

The "reaches" over "Wreck shoal" are not long enough to warrant the erection of "range lights."

I consider it necessary that the present buoys be *replaced* by *larger ones*; and as the forest on each side gives a dark back-ground, they should be painted *white*; they would then always be seen on a star-light night.

I also propose that "tripods," painted white, be erected on jetties Nos. 3, 4, and 6. They would materially assist the navigator in

avoiding the shoals, and *jetties themselves*, which are low in the water, dilapidated, and more dangerous to vessels than beneficial to the river.

* * * * *

A requisite light-house for the upper eastern jettee should not cost over four thousand dollars.

Very respectfully, your obedient servant,

J. N. MAFFITT,

Lieut. Com. and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 30, *bis*.

Letter from the President of the Chamber of Commerce of Charleston, S. C., to the Superintendent of the U. S. Coast Survey, requesting a tracing of the chart of Charleston harbor.

CHARLESTON, June 18, 1851.

DEAR SIR: At an extra meeting of the Chamber of Commerce of Charleston, held this day, the enclosed resolution was unanimously adopted, and I was instructed to transmit you a copy, and express the hope that you may be able conveniently to comply with our request.

We desired a copy of this chart to assist us in forming some opinion of the best method of improving the entrance to our harbor. Public attention has long been attracted to the "Sullivan's island" channel, as offering strong inducements to attempt some improvements there, and the developments made by the Coast Survey tend strongly to encourage this feeling. If you have had your attention attracted to this subject, and adopted any definite views in relation to it, you would be doing essential aid to a subject of vast public importance and profound interest to our community by making your opinions known.

Yours, with great respect,

G. W. TRENHOLM,

President Charleston Chamber of Commerce.

Prof. BACHE, *Washington.*

Resolved, That Professor Bache be respectfully requested to furnish the Chamber of Commerce, for the use of the mercantile and navigating interests of Charleston, a tracing of the chart of Charleston harbor, recently constructed under the direction of the Coast Survey.

APPENDIX No. 30, *tris*.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating sailing directions for the entrance into North Edisto harbor, by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey.

COAST SURVEY OFFICE, April 28, 1851.

SIR: I have the honor to communicate the following information, supplied by Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, in relation to North Edisto harbor, and to request authority to publish it for the benefit of navigators:

"This harbor of refuge is about sixteen miles to the southward and westward of Charleston light-house. It is easy of access—one course over the bar taking the vessel to a safe anchorage.

"In four fathoms water, (with the point of Seabrook island, on the north side of the harbor, bearing northwest,) you will be close up to the bar.

"Bring Bare bluff (a remarkable clump of trees which stands back from the entrance about ten miles, and can be easily recognised by four tall trees rising above the others) about four hand-spikes to the left of Seabrook point, and run in on that range.

"When almost off the starboard sand-spit, keep in mid-channel, to avoid a sand-flat on that shore. By keeping near mid-channel, good water may be carried up to the anchorage, abreast of Mr. Legaré's, (the first house upon the port shore.)

"At 'mean low-water' there are thirteen feet on the bar. The mean rise and fall is six feet. The ebb-tide on the bar tends to the southward and eastward—the flood north-northwest.

"The establishment of North Edisto, for two months' tidal observations in 1851, is seven hours nine minutes."

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent*.

Hon. Wm. L. HODGE,

Acting Secretary of the Treasury.

APPENDIX No. 31.

Report of F. H. Gerdes, esq., assistant in the coast survey, to the Superintendent, on the reconnaissance of the coast of Florida, from the Suwannee river to the St. Martin's reef.

PASCAGOULA, December 20, 1850.

SIR: In compliance with your orders, I left Pascagoula November 2d, for the Cedar keys, Florida.

* * * * *

The first section was the Cedar keys and the reefs to the eastward; then I examined Wacassassa bay, Suwannee reef, Withlacoochee bay, Crystal river, and St. Martin's reef.

Observations for latitude and time were made almost daily. A tide-gauge was kept for about twelve days, and the necessary soundings to mark the several channels were taken. The heights of several hills were measured, and a special reconnaissance was made for a base to be used for a preliminary survey. A small base, upon which all the bearings and angles depend, was twice measured, and, on many important points, signals were left to designate them.

Description of the Coast.

1. *Suwannee river and bay.*—The Suwannee, one of the principal rivers on the coast of Florida, is deep, and has very fertile lands on its borders. The country is flat and densely wooded—the forests consisting of pine and other kinds of timber. Sugar and cotton are cultivated in considerable quantities, and many acres are cleared yearly in the hammocks. The mouth of the river is shoal—bars obstructing both outlets. The lower or southeast outlet, however, is the best, and is now generally used. The northwest outlet, near Bradford's island, is entirely abandoned. An oyster reef runs, in a horse-shoe shape, before this river, and forms the Suwannee bay, which is equally shoal. More than five feet at high-tide cannot be carried either over the bar, into the bay, through the bay, or into the river itself. A steamboat plies on the river to Depot key, carrying passengers and produce (cotton and sugar) to the shipping places of the vicinity.

2. *Cedar keys.*—The Cedar keys form a group of islands making out from a point of the main land, just below the Suwannee reef, to the southward. The greater portion of these keys is connected with the main, and only at high tides they are separated by small boat-channels. Several of the keys, however, extend for a few miles farther to the southward, and these, of course, are islands proper.

The Cedar keys consist of Way key, Scale key, Big key, Flat key, Black Point key, and numerous others, only divided by small passages; none of which, however—except old No. 4 channel—are fit even for boats. The keys are cut up into numberless patches of marsh sand, beach, mangroves, and wood; but as the surface was surveyed in detail by the corps of topographical engineers, I have only delineated the outlines. On Way key there is an elevation of about fifty feet; and other hills, of a minor class, are formed on Lime Point, Black Point key, Live-oak key, &c. The islands proper belonging to the Cedar keys are North key, Sea-horse key, Depot key, Snake key, Derrick's key, Dog island, and several minor ones.

North key is wooded—has two large ponds—is hilly in the middle, and has a house on it, though uninhabited.

Sea-horse key is the southern key—is forty-five feet high—has a long, hilly ridge, an uninhabited house, and an excellent harbor close to the eastern point. In the war with the Indians, Sea-horse key was occupied by our troops.

Depot key is the anchorage of the Cedar keys—is inhabited by ten or twelve families, and affords quite a fine view. There are here hospitals and storehouses, and several cottages, overhung by tall palmetto trees. A handsome wharf, and the appearance of business, enliven

the sight. All the cotton and sugar of the neighboring rivers are taken by flats to this place, and shipped from here either to Mobile or to New York. From fifteen to eighteen vessels arrive here yearly for this purpose, and probably as many more transient ones.

Snake key forms a triangle with the Sea-horse and Depot keys, is hilly, but small, and affords some protection to the harbor of Depot key from southeast winds.

Derrick key, situated to the west of the main group, is small, and separated from the others by the steamboat channel to the Suwannee bay.

Dog island, northeast from the Depot, is small and low, and contains only mangroves and a few cabbage-trees.

Channel No. 1—three channels.—The principal channel to the anchorage at Depot key runs east of the Sea-horse, and fourteen feet have been carried in here, at a good tide. The channel is plain enough, when known and well staked out.

Channel No. 2—small channel just below the Sea-horse, across the reef—is little used; but I am assured that eight feet water may safely be carried. A survey of this channel would be useful for smaller vessels, as it would avoid the necessity of doubling the Sea-horse reef, (fifteen miles long.)

Channel No. 3.—Another channel comes in from the westward, between Sea-horse and North keys, just above (north of) Bird key. At a good tide, nine feet may be carried in. The channel is plain and well staked out.

Channel No. 4.—This channel, although it has the best water, is very little or not at all used, as it does not extend to the anchorage. It runs from the westward about half a mile above North key, and carries fourteen feet of water to the first and second Mangrove keys; then it suddenly stops, and the anchorage at the termination remains quite exposed to westerly winds. It might be used in good seasons, with the aid of lighters, but it would be unfit for the railroad terminus, for the above reason; and, besides, it would be very expensive to extend the track so far over very low, marshy ground, and partly over shoal water.

The reef of Sea-horse key runs from the Sea-horse for ten miles SW., and thence for five miles SSW., and has shallow spots of only a few feet of water. A moderately-sized coasting vessel touched lately on the southernmost point, not having Sea-horse key even in sight.

4. *Wacassassa bay.*—The coast of the main from Cedar keys runs for more than ten miles in nearly an eastern direction, viz: from Live Oak Point, and "old block-house No. 4," (garrison fort of the Florida war,) to the Wacassassa river, from whence an angle to the south is formed. The coast is flat, and for one or two miles inland marshy, where the dense and uninhabited forest commences, and stretches for miles into the country. This whole shore is a complete oyster-bed; I never in my life saw such enormous quantities together. Many reefs formed of the same shell run across the bay, mostly in a parallel course with the coast.

One channel, between the western reefs, carries eight feet water in the bay; another, between the eastern reefs, has ten feet; but they stop suddenly. The Wacassassa river is similar to the Suwannee river; has very fertile hammocks on the borders, and the plantations of sugar and

cotton are in a flourishing condition. The soil contains marl, and, it is said, under the same for sixteen feet, clay. The depth of the river is considerable, but not more than five feet can be carried, under the most favorable circumstances. All shipments from here are made in flat-boats, to Depot key.

5. *Withlacoochee bay*.—Below, to the south of the Wacassassa bay, the Withlacoochee bay begins, and forms the mouth of the river of the same name. The shores of the bay are similar to those of the Wacassassa—low, flat, marshy, intermixed with mangrove bushes, and a mile or two inland very thickly wooded. The point of land in the middle, between the two rivers, is called Mangrove Point. The whole bay is very shoal, and not more than three or four feet of water can be carried into the river. The latter has very little hammock land, and is less settled than the other rivers, perhaps on account of the difficulty of navigation. An oyster reef extends a few miles from the river's mouth into the bay.

6. *Crystal river and bay*.—From the Withlacoochee the shore runs southward, making a slight curve to the east. Five miles below is the Crystal river. The nature of the border is similar to the Wacassassa and the hammock land, equally fertile and rich. At the mouth of the river is Shell island, the channel into the river running on the north side. The island is rather elevated, being formed by two hills in saddle-shapes, which make a fair landmark for navigation. From the mouth of the river, or rather from the south side of the entrance, the St. Martin's keys commence, and extend for two or three miles to the west, thence turn in an angle southward again. These keys are low and marshy, and generally thickly covered with mangroves. Outside of these is the famous and very dangerous St. Martin's reef, which runs parallel to the coast, to the southward, and extends at some points as far as ten miles to sea. It is said this reef extends to the Anclothe keys, a distance, perhaps, of from fifteen to thirty-five miles, which I am inclined to believe. While I was beating up the coast, I generally ran in nine or ten feet of water on the land tack, without ever being able to see the coast.

To the north of this reef, just abreast of Crystal river, is a fine anchorage, into which vessels may run for refuge, with from sixteen to twelve feet water, perfectly safe for southerly, easterly, and northerly winds. Even from westerly gales there is much protection here, the Sea-horse reef breaking much of the heavy sea. I have called this anchorage Crystal river offing, as the name St. Martin's bay is altogether inappropriate, and does not designate the place. From the offing a channel runs through the oyster reef, which encircles the mouth of Crystal river, and consequently forms a beautiful harbor. I found twelve feet at low tide through the principal gut; and, as the inlet is the only one of any consideration, I have left two large signal-poles on each side, on the oyster bars. It must be borne in mind that the tide rises here two, and frequently three feet, and that therefore, under favorable circumstances, fourteen feet can be carried in. The importance of such a harbor is very great, as it must and will become the shipping port of all the produce for the neighboring rivers, viz: the Withlacoochee, the Crystal river, the Homossassa, and the Chassahowitzka. The

Homossassa is only five miles below the Crystal river, and the Chassahowitzka about ten miles; but neither has any channel through the St. Martin's reef, and their produce, which will be in a short time quite considerable, has to be shipped from the nearest harbor.

The honorable Senator from Florida, Mr. Yulee, mentions, in a letter to you, the reported existence of a harbor and anchorage below the Cedar keys, with fourteen feet water, but he does not intimate the position nearer. I am certain that the harbor of Crystal river is the one he mentions, as there is no other channel to be found anywhere above.

B.—Survey of the Coast.

1. *Triangulation.*—The country from the Suwannee river to Homossassa river is so shaped that the regular method of the Coast Survey in all branches may be employed for the survey of the same. There are facilities which may be used in laying a good-shaped triangulation with very little clearing across the islands and along the coast. With the aid of several oyster bars, which are solid and above high-water mark, the shape even may be handsome, although the nature of the flat country does not admit of very large sides. The triangles, as projected on the map, will show at once the possibility, and, with one or two exceptions, the whole series will appear well-shaped and of regular formation. The sketch shows the proportions, facilities, and difficulty of the triangulation. One of the above-mentioned exceptions is an artificial signal to be erected off the Withlacoochee river. Without making a proposition at present, I should think that one or two screw-piles for soft bottom (I say two for a double series) would answer exceedingly well.

Signal-poles can be procured from either river, especially on the Wacassassa.

2. *Topography.*—There being little or no land under cultivation near the coast, the whole being marsh and wood, the topography will be very simple. To extend the survey further into the country than the woods would be impossible, as they are impenetrable for instruments; besides, there is nothing behind them. The plantations on the river generally do not approach nearer than seven or eight miles to the shore, and therefore cannot be included in the survey. A plane-table may be used here with great success, as the off-shore reefs afford a thousand opportunities for intersecting signals. The surveying compass must be employed with great care, as the coast from Mangrove Point above the Withlacoochee, all the way down, is rather rocky, and supposed to contain much local attraction.

3. *Hydrography.*—The hydrography can be carried on with success in small vessels and boats. There is seldom any sea inside the Sea-horse reef. Snake key and the Sea-horse being elevated, afford excellent points for high signals.

4. *Astronomy.*—Sea-horse key, being the most important key for navigators, possesses all the facilities for an astronomical station.

5. *Base lines.*—I have paid every attention during the investigation of the coast to find suitable sites for a base line, upon which the triangulation may be grounded, but I have been unsuccessful so far. The marsh along the shore has no stability for our apparatus; the land,

wherever it is solid, is uneven or thickly wooded. A more special reconnaissance has to be made for the purpose: perhaps more to the northward a site may be found, combining in a moderate degree the necessary requisites. If the railroad should be built, we may get a site then from Way key. As it is now, nothing there is to be found. Even for a preliminary base, the best site I could find is only one and a quarter mile long, and requires much clearing and labor—touching, besides, two ponds, the distance of which has to be ascertained by triangulation and measurement around. From here, however, the triangles may be gradually increased and retain good forms. The line is on Way key. A topographical sketch of the site is appended.

The atmosphere on the coast, during my stay, was rather hazy, but not near so bad as we find it generally in Section VIII. Five days, however, it was perfectly clear, and Sea-horse key was seen distinctly for twenty miles. Refraction was sometimes very great.

C.—Tides and Currents.

During my stay at the Cedar keys the tide was observed, on the wharf of Depot key, for seven days. The diagram on the map will show that it consists of a full and a neap tide nearly every twenty-four hours. The following are the results:

Mean-tide rises and falls.....	1 foot 9.8 inches.
Spring-tide “ “ “	2 feet 7.5 “
Average of both rise and fall.....	2 “ 2.4 “
Time of rise and fall, 24 hours 40 minutes.	

In the map of Cedar keys published by the Topographical Engineer corps, the average rise and fall is 2.75 feet. I do not know whether my observations were of too short a duration; but the above is what I found.

On the coast outside and to the southwest of the keys, the general tendency of the current is to the southward. It is uncertain how much prevailing winds and storms may influence them. The pilot of the keys asserted that the currents were altogether governed by them, and that sometimes they run in quite an opposite direction.

D.—Railroad across the Peninsula of Florida.

By the survey of the officers of the United States Topographical Bureau, it appears that Way key was proposed as the terminus of the railroad on the gulf shore. How far this, in regard to the track itself, is advisable, I cannot judge; but it seems to me, certainly, by far the most desirable spot in regard to the harbor. At Way key and Depot key there is a safe anchorage; and although the channel is rather narrow, still it is sufficient for vessels of large size to turn in. Twelve feet may be carried, ordinarily. The pilot, Captain Sam. Johnson, assured me that fourteen feet can be carried, if circumstances are favorable.

The only harbor besides this is Crystal harbor; but vessels have to lie about two miles from the main land; and furthermore, the railroad itself would have to cross several rivers and marshy plains to reach this shore.

E.—Light-houses and Buoys.

There are no lights in the neighborhood of Cedar keys; but I hear that an appropriation for one has passed in Congress, and Captain M. Coste, of the revenue service, in the cutter Crawford, has made an investigation for the special locality. I am confident that Sea-horse key has been selected for that purpose, as there is no other place near so suitable; but as I have had probably more opportunities to see the localities than the above-mentioned gentleman, during his short stay, I beg leave to remark, that on Sea-horse key the highest land is just to the southwest of an old shanty, or fish-house, which stands on the east beach of the island. By actual measurement, by vertical angles, I found 45 feet 6 inches above high-water. As the reef from this key runs out for fifteen miles, it will be desirable to occupy the highest spot, that the light may be visible from beyond it. There ought to be a buoy placed on the point of this reef, by all means. In foggy weather the Sea-horse is invisible from there, and the reef is very difficult to distinguish, as the water outside deepens only gradually, and retains the same color. A screw-pile, (disk-screw,) with a barrel, could be inserted easily, the reef having only quicksand and a sort of coral sand.

F.—General Remarks on the Harbor of the Cedar Keys.

It is obvious, by looking at the map of the western coast of the Florida peninsula, that in a severe southwest storm the navigation must be very dangerous. From Tampa Bay to St. Mark's the coast is generally shoal, and, with the exception of the Cedar keys, no harbor of refuge is to be found. At the latter place the coast forms a point, and through the position of the keys and Sea-horse reef, quite a large bay is formed, in which vessels may run with almost every wind, and find shelter at any time.

This will be still more the case when the light-house on the Sea-horse key has been built, by the aid of which every part of the bay may be safely entered in dark and stormy nights. Not alluding at all to the commerce from the four or five rivers which empty, close to the keys, into the Gulf, and which is concentrated entirely at Depot key, but alone for the sake of a safe and spacious harbor in westerly gales, it is most desirable to develop all the facilities which the Cedar keys bay may afford, and to commence a regular survey at the earliest opportunity. Five large streams are, in fact, combined at the Cedar keys, and the produce to be shipped from there doubles yearly. The place will become still more important after the building of the railroad from the St. Mary's across the peninsula, and the erection of a light-house on the Sea-horse.

A survey, grounded upon a preliminary base, might be made in a short time, and it would be practicable to publish a harbor chart comparatively very soon.

Respectfully submitted:

F. H. GERDES,
Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent Coast Survey.

APPENDIX No. 32.

Extracts from the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, to the Superintendent, of a reconnaissance of Mosquito inlet.

UNITED STATES COAST SURVEY OFFICE,
Washington, July 19, 1851.

SIR: * * * This inlet is made by the Halifax and Hillsborough runs, which, at their meeting, force an outlet to the sea.

Mosquito inlet has, for a number of years, been moving to the southward. The light-house formerly erected at Mosquito was built upon a high sand-hill on the southern peninsula, about an eighth of a mile from the water. In two years it fell down, undermined by the southward movement of the inlet. The place of the light-house is now said to be about high-water mark on the north beach.

The south beach is still rapidly washing away, and the north beach extends to the southward as fast. Mr. Sheldon, collector at Mosquito, says that the barrier about half a mile to the northward of the present position of the inlet is rapidly washing away. He infers that the water will soon cut a passage there, when this new opening will become the entrance to the harbor, and the present inlet close. His opinion is the result of long observation. I have no means of forming any opinion of my own as to its correctness.

As many as thirteen small vessels have, I understand, been lying in the harbor at once, waiting for cargoes of live-oak, but none very lately. A few plantations make sugar, which is here exported. I did not learn of any other trade worth mentioning. I do not deem the commerce of Mosquito sufficient to demand the erection of a light-house.

* * * * *

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieut. Com., Assistant U. S. Coast Survey.

A. D. BACHE, LL. D.,

Superintendent Coast Survey.

APPENDIX No. 33.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, in regard to the expediency of placing buoys in Mosquito inlet, Florida, and transmitting the report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey.

COAST SURVEY STATION,
Near Alfred, Maine, October 1, 1851.

SIR: In pursuance of the act of Congress approved March 3, 1851, and of the instructions of the department, I have the honor to report in regard to the expediency of placing buoys in Mosquito inlet, on the

eastern coast of Florida, and to transmit for details a report of Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, by whom an examination of the inlet was made. I send herewith a copy of the sketch of the reconnaissance.

I concur in recommending the placing of these buoys as stated by Lieutenant Commanding Rodgers, with the precautions which he suggests for their maintenance in the right positions, and for the change of place of the bar buoys according to the change of the bar itself.

I would further recommend that Lieutenant Commanding Rodgers be intrusted with the placing of these buoys in the first instance—a duty which can be performed as he returns to Section VI, the coast of Florida.

Important suggestions of local signals for pilotage of barred harbors are given in Lieutenant Commanding Rodgers's report, and are hereto appended for the examination of the department.

Very respectfully, yours,

A. D. BACHE,
Superintendent.

HON. THOMAS CORWIN,
Secretary of the Treasury.

—
UNITED STATES COAST SURVEY OFFICE,
Washington, August 29, 1851.

DEAR SIR: The position of the proposed buoys at Mosquito inlet, Florida, cannot be usefully marked on the sketch.

As the bar shifts with every gale, the best water is not now, in all probability, where it was when the examination was made.

I think three buoys would be ample. I venture to propose a second-class buoy outside of the bar; a third-class buoy inside; and a third-class buoy at the bar.

To be useful, or rather that it may not become a nuisance, the bar buoy must be carefully attended, and its place changed with every alteration in the position of the channel. For this buoy spare moorings should be furnished, as it is probable that after every change of bar the shifting sand will so have covered the anchor that every attempt to weigh it will be fruitless; in which case, to unshackle the buoy and expend new moorings will be the only resource.

The collector is allowed boat hands. These men might be required to keep the buoy in the best water, and the collector be held responsible in his office for the faithful discharge of this duty. To this end a log or frame house should be erected on the beach for the men to live in. The beach washes away so fast that it is scarcely desirable to use more durable materials.

There is now no regular pilot for Mosquito, because there is not enough commerce to support one. The boat hands employed to keep the buoy in the best water would necessarily know the state of the bar, and be competent to point out the channel. Living on the spot, they would always be ready to pilot vessels. Mount Pleasant is the

nearest habitation to the inlet; and at present, since no look-out is kept, it is only by chance a vessel is seen.

On account of the breakers it is often impossible for a row-boat to cross the bar; the pilot must then wave the vessel in by means of a flag. In such harbors conventional telegraphs are established, as at St. Augustine, Florida, and Rio Grande de San Pedro, in Brazil, by which the vessel indicates her draught of water, and the pilot gives directions to her for keeping in the channel.

It is desirable that this telegraph should be general to all the barred harbors of the United States, and not varied in different localities, and at the pilot's discretion.

I have ventured to propose the annexed table as perhaps sufficient. It is simpler than the Brazilian telegraph, and fuller than the St. Augustine one.

Such modifications as may be deemed necessary can easily be made on it.

Very respectfully, your obedient servant,

JOHN RODGERS,

Licut. Commanding, and Asst. Coast Survey.

To A. D. BACHE, LL. D.,

Superintendent Coast Survey.

Table of signals for piloting vessels into barred harbors.

The pilot's flag to be seven feet by six in size, and to consist of two triangular red pieces of red muslin, or bunting, enclosing a white triangle of the same materials, fastened to a staff twelve feet long and one inch in diameter. The end of the staff to have a barrel hoop firmly lashed to it, and to have stretched over the hoop a piece of muslin, the upper half white and the lower half black.

The pilot boat to approach the bar as nearly as she safely can. The pilot lays on his oars, or anchors his boat. The boat should be fitted with an awning stanchion aft, and a strap around it, for the pilot to make himself fast to, that he may stand steadily while signaling.

Sentences to be communicated to the pilot by the vessel.	Signals for sentences opposite.
1. The vessel wants a pilot	Jack at the fore.
2. Indicate my draught.....	Dip the flag once for every foot which the vessel draws, and run it half up and dip it once for every quarter of a foot.
3. In distress; I must try to come in at high water.	
4. In distress; I must try to come in now...	Flag, union down.
*5. I am sinking, or on fire; run me ashore in the best place.	Flag, union down, dipped four times.
	An overhand knot in the middle of the flag, dipped four times.

* The bar is not always the best place for beaching a vessel while the breakers are very heavy on it; there may be a comparatively smooth place on the sea-beach.

Table of signals—Continued.

Sentences to be communicated to the vessel by the pilot.	Signals for the sentences opposite.
1. Pilot cannot come out; what water does the vessel draw.	Wave the flag to right and left.
2. Not water enough on the bar until high tide.	Pilot raises the flag over his head, and dips it towards the vessel once for every hour she must wait.
3. The vessel cannot enter until the wind changes.	Flag and ball horizontal; staff held by the middle.
4. Not water enough on the bar; seek another part.	Waves black and white ball to right and left.
5. Vessel cannot cross the bar until the sea goes down.	Ball inclined 45 degrees to the horizon; flag in left hand, as pilot faces the vessel, and staff in the right hand.
6. The vessel may get under way and stand for the bar.	Pilot holds the flag erect over his head, and keeps it so until the vessel weighs; he may incline it the way he wishes her to cast.
7. Steer the vessel to starboard, or port the helm.	Incline the flag to } In both these signals the
8. Steer the vessel to port, or starboard your helm.	Incline the flag to } flag points out the side
9. Steady, or steer as you go.....	Dip the flag out of sight.
10. Steer for the pilot boat.....	Flag overhead; staff upright.
11. Anchor.....	Ball overhead; flag in pilot's hand.

APPENDIX No. 34.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon the necessity for a light-house, or permanent beacon, on the Rebecca shoal, between the Tortugas and Marquesas, Coast of Florida.

COAST SURVEY OFFICE,
November 22, 1851.

SIR: I would respectfully call the attention of the department to the necessity for a light-house, or at least for a permanent beacon, on the Rebecca shoal, between the Tortugas and Marquesas, in the Gulf of Mexico. The position of the shoal is shown in the annexed sketch. It lies in an important thoroughfare for vessels bound into the Gulf, and is not now marked. My attention has been called to this subject by Assistant F. H. Gerdes, of the Coast Survey, who made the reconnaissance of the Florida keys and reefs, and who has presented two drawings—one for a beacon to serve as a light-house, and the other for a simple beacon—which are at the disposal of the department, if their communication is desired. I send herewith a letter of Lieutenant Commanding John Rodgers, United States navy, assistant in the Coast Survey, in charge of the hydrographic party on the coast of Florida,

to Mr. Gerdes, in reply to his inquiries relative to the necessity for a light on the Rebecca shoal, and to the plan for a structure to contain it.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

COAST SURVEY OFFICE,
Washington October 21, 1851.

DEAR SIR: In reply to your letter of this morning, I beg leave to say that I think no doubt can exist in the mind of any person acquainted with the facts of the case, as to the great necessity to commerce of a beacon on the Rebecca shoals.

The passage between the Marquesas keys and the Tortugas is a great thoroughfare for vessels bound into the Gulf of Mexico. By taking this passage the time to ports in the gulf is shortened more than the mere distance cut off, since the current is thereby avoided sooner. To sail vessels this is, in light or head winds, of the greatest importance.

The shoals which lie in this passage are very dangerous, and there is now no mark for them. For want of some such mark, scarcely a day passes without many vessels running a great risk of injury or loss.

The beacon of which I saw a draught in your room would undoubtedly stand; the plan combining great strength with little surface.

Any beacon put on the Rebecca shoals should be built, as the one you propose, with reference to its ultimate conversion into a light-house.

I would prefer, however, that the whole structure should be of iron, rather than part wood.

With a given strength, iron offers so much less surface to the wind or sea, and it is of so much greater durability, that the increased cost of iron is by no means commensurate with its advantages.

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant U. S. N., and Assistant Coast Survey.

F. H. GERDES, Esq.,

United States Coast Survey.

APPENDIX No. 35.

Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys and beacons for entrance to Mobile bay.

COAST SURVEY OFFICE,
August 20, 1849.

SIR: The following report upon the location, &c., for buoys and beacons for the entrance to Mobile bay is respectfully submitted:

Buoys.

1. A buoy, or, far better, a boat-buoy, with a heavy bell, just outside the bar, in eight and three-quarters fathoms, soft bottom, with Sand Island light-house bearing north 22° west, and distant from the bar one mile. A buoy is necessary at this place at all times, but much more so during the thick, hazy, and foggy weather, prevailing nearly through the most active season, when a bell would be of great benefit.

2. A buoy off the south end of West Bank, in twenty-five feet water, with Sand Island light-house bearing south $11^{\circ} 30'$ west, distant 1.78 mile, on a range of Mobile light-house, on West Umbrella Tree.

3. A buoy off the north end of West Bank, in forty-eight feet water, with buoy 2 bearing south $11^{\circ} 30'$ west, in range with Sand Island light-house, distant 1.68 mile, and Mobile light-house bearing south $55^{\circ} 30'$ east, distant 1 mile. The line joining buoys Nos. 2 and 3 will clear West Bank.

4. A buoy off the southwest end of Middle Ground, in twenty-five feet water, with Mobile light-house bearing south $28^{\circ} 30'$ east, distant 1.66 mile.

5. A buoy on the northeast edge of West Bank, opposite to the southeast end of the Middle Ground, with buoy 4 bearing south $42^{\circ} 30'$ east, distant 1.82 mile. The line joining buoys Nos. 3 and 5 will clear the northeast edge of West Bank.

6. A buoy on the twelve-feet spot (northeast end) of the Middle Ground.

7. A buoy on the southwest point of the spit, in nine feet water.

These buoys should be large, and of such construction as to be seen some distance; and of such form, and so colored, as to be known when seen in foggy weather, and to point out on which side they are to be passed. The system adopted for this purpose should be based upon the principles proposed by the late Lieutenant G. M. Bache, United States navy, in a report upon the buoys of Long Island sound.

Beacons—Entrance to Mobile Bay.

1. A beacon on Sand island, with the light-house bearing north 22° west, distant 245 feet. To cross the bar with beacon on the light-house.

2. A beacon on Sand island, with light-house bearing south 83° west, distant 145 feet, and beacon 1 bearing south 11° west, distant 250 feet, so that beacon 2, in range of beacon 1, shall clear the west bank.

3. A beacon on Revenue point, the south end of east bank. This beacon would bear nearly the same relation to this entrance that the "Rower beacon" bears to that of New York.

4. A beacon on Mobile point, with the light-house bearing south 34° east, distant 140 feet, near the water, and on the range of the black barrel over the chimney of the frame-house on middle of light-house; to lead through the channel between the southwest point of the Middle Ground and northeast edge of West Bank.

5. A beacon on Mobile point, with the light-house bearing north 46°

30' east, distant — feet; and beacon 4 bearing north $16^{\circ} 30'$ east, distant 240 feet; so that beacon 5, on beacon 4, shall clear east bank, and beacon 5, on light-house, shall lead into the east end of Sand Island channel.

I would propose that beacons 1 and 4 have red lights, and beacons 2 and 5 white lights. Flashing and fixed lights would do better, but are more expensive. It would not be necessary to light beacon 3, and it would be an advantage.

It would not be required to see these beacons more than three-and-a-half miles; therefore, arcs of single reflectors (or, better, the Argand burner, with a single wick) would be sufficient; and they need not be over twelve or fifteen feet in height, made strongly, of rough wood.

Beacons 2, 3, and 5 should be black; beacon 2, because it would show against the sky, and to distinguish it from beacon 1, (as in red and white lights, flashed, &c.;) beacon 3, because it shows against the sky; beacon 5, because it shows against the sky, and to distinguish it from beacon 4. Red would probably be a better color than black. Beacon 1 should be black (or red) on the southeast side, as it would show against the white of Sand Island light-house, and white on the north side, to distinguish it from beacon 2. Beacon 4 should be white, as it would show against the green glacis of the fort, and to distinguish it from beacon 5. These beacons could be re-erected and kept lighted at a small expense, and no additional assistance would be required to the light-house keepers to keep them up. A buoy on the northwest end of the northwest Pelican shoal, and a beacon on Dauphin island, so placed that a bearing upon it would be the course into Pelican pass from outside, would be very useful to the mail-steamboats between New Orleans and Mobile during the winter months, when the north winds prevail, and the water is too low for them to use Grant's pass, the inside route.

At present the marks for this entrance are very inferior; those for the West Bank can scarcely be called such at all; and the mark leading through between the Middle Grounds and the northeast edge of West Bank is of the rudest kind, small, and during hazy weather can scarcely be seen, except with the sun to the westward. In foggy or thick weather, though knowing themselves off the bar, from the soundings and bottom, yet these cannot give their position with sufficient accuracy to allow the pilots to cross the bar, which a bell-buoy would enable them to do with great ease. The entrance to this bay, through which passes a yearly commerce of twenty millions, has no other marks or safeguards than the two light-houses, which are very inferior to the third order of French lights.

I would therefore respectfully urge the great necessity of calling the early attention of the department to these buoys and beacons.

I will merely state, that during the past year \$40,000 worth of property has been lost on or near the bar, and \$20,000 and upwards has been paid for salvage; and this, in the opinion of all, for want of good marks to clear the dangers.

These amounts I will forward as soon as they are obtained from the

agent of the underwriters at Mobile, who promised to forward them to me. The precise amount of loss and salvage, however, is over \$60,000.

Very respectfully, your obedient servant,

C. P. PATTERSON,

Lieutenant Commanding, and Assistant Coast Survey.

Professor A. D. BACHE,

Superintendent United States Coast Survey.

APPENDIX No. 36.

Report of Lieutenant Commanding C. P. Patterson, United States navy, to the Superintendent of the Coast Survey, on buoys for Cat and Ship Island harbors.

COAST SURVEY OFFICE,

Washington, August 20, 1851.

SIR: The following report upon the location, &c., of buoys for Cat and Ship Island harbors is respectfully submitted:

1. A buoy just outside of Ship Island bar, in twenty-three feet water, hard, sandy bottom, with the west end of Ship island bearing north 53° east, to cross the bar in that course.

2. A buoy off the east end of Spade-fish shoal, (off north spit of Cat island,) in sixteen feet water, soft bottom, with Cat Island light-house just on with north point of north spit.

3. A buoy on northeast edge of Cat Island bar, with the west end of Ship island bearing north 66° east, distant six miles, south end of south spit of Cat island bearing north 71° west, distant two and a half miles; and Sand Hill bearing north 5° west.

4. A buoy at the southeast end of Cat Island channel, in eighteen feet water, soft bottom, with south end of south spit bearing $11^{\circ} 30'$ west, distant one and a half mile; so that a course of south 71° west, distant two and one-fifth miles, between beacons 3 and 4, shall lead through the channel over the bar.

5. A buoy on the north side of Cat Island channel, near the northwest end of the mud-hole, eighteen feet water, hard bottom, with the south point of south spit bearing north 73° east, distant one and one-third mile; and Cat Island light-house bearing north 36° west, distant four miles.

6. A buoy off Potato Hill, with Cat Island light-house bearing north 5° west, distant two and a half miles. This buoy should be placed off the southwest point of Potato Hill, in eighteen feet water.

7. A buoy off the east end of Pistol shoal, in eighteen feet water, with Cat Island light-house bearing north 24° west, distant two and two-thirds miles; and the northwest point of Isle au Pied bearing south 42° east, distant one and two-thirds mile.

8. A buoy off the north edge of Pistol shoal, in sixteen feet water, with Cat Island light-house bearing north 52° east, distant three miles; and buoy No. 7 bearing south 71° east, distant one and a half mile.

9. A buoy off the west end of Pistol shoal, in eighteen feet water, with Cat Island light-house bearing north 52° east, distant four and a

half miles; and buoy No. 8 bearing north 70° east, distant one and a half mile.

The want of land-marks makes the necessity of so great a number of buoys.

The increasing commerce of the coast will, in time, demand greater facilities for navigation, in several beacons and an increased number of buoys; but the buoys named above are deemed sufficient for present purposes.

The importance of the channel south of Cat island, through which a large portion of the smaller trade to and from New Orleans must pass, and of Ship Island harbor, as one of refuge, will be strongly felt as this trade increases, which it is rapidly doing.

Very respectfully, yours,

C. P. PATTERSON,

Lieutenant Commanding, and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent.

APPENDIX No. 37.

Letter of the Superintendent of the Coast Survey to James E. Saunders, esq., of Mobile, communicating sailing directions for Horn Island pass.

U. S. COAST SURVEY OFFICE,

Washington, May 27, 1851.

DEAR SIR: Upon the receipt of your communication of March 21st, I addressed letters on the subject to the assistants engaged on the Coast Survey in the locality embraced in your inquiries. Answers to those letters I have just received, and with pleasure communicate to you such information as the operations of the Coast Survey enable me to furnish. I wish that that information was more definite; but the hydrographical survey of Mississippi sound is as yet incomplete, and that at Grand bay has not yet been commenced. When the latter is made, it is possible, though not probable, that better water may be discovered in that bay than indicated by present information.

To pass through Horn Island pass, bring Round Island light-house to range about 150 yards over the east end of Horn island, and the woods on Petit Bois island to bear E. $\frac{1}{2}$ N. There are here about four fathoms of water, whence a north course will take a vessel over the bar in not less than fourteen feet water, passing close to the spit of Horn island, (within 100 yards,) after passing three-quarters of a mile inside of Horn island, or until Round Island light-house bears WNW., stand east, (to avoid the shoal of La Grande Batture,) until the west end of Grand Batture island bears about N. by W. Along this line there are from eighteen to twenty feet water. A NNE. course will then take a vessel to the mouth of Grand bay; or a direct course may be made for Point aux Pines, until opposite the mouth of Grand bay, (the water gradually shoaling to eleven feet,) which lies between two spits, (bare at low water,) and is about three hundred yards in width. Across the bar, at the entrance

of Grand bay, nine feet water can be carried at high tide. Inside of the bar the water suddenly deepens to four fathoms, and thence gradually shoals to the mouth of Heron bayou, which, I presume, is the "creek" to which you refer. At the mouth of the bayou there are three feet at high water; but a continuous strong north wind will so depress the water in the bay as, at such times, to leave the mouth of the bayou bare at low water. There is no bar of hard bottom at its mouth, the whole being a muddy flat, through which scarcely any appearance of a channel can be traced.

There is no difficulty or danger in the navigation to the eastward of Grand Batture shoal, the bottom being smooth and even, (soft mud,) and shoaling gradually to "Isle aux Herbes." In beating against a hard wind between Grand Batture shoal and Petit Bois island, the lead will always indicate an approach to the shoal, which is of hard mud, while the bottom is elsewhere soft and sticky.

I trust that the preceding conveys the information sought by your inquiries, and shall be gratified if it prove to be of any service to you.

Yours, respectfully, &c.,

A. D. BACHE,

Superintendent United States Coast Survey.

JAMES E. SAUNDERS, Esq., *Mobile.*

APPENDIX No. 38.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury on light-houses in Galveston bay, with a report of Lieutenant Commanding Craven, United States navy, assistant in coast survey.

COAST SURVEY OFFICE, June 17, 1851.

SIR: I have the honor to report in relation to the light-houses in Galveston bay, for which appropriations are made in the act of March 3, 1851, and in relation to which preliminary surveys have been required by the department. The lights are numbered 30, in the lists heretofore transmitted, and renewed in my communication of the 13th instant.

The three proposed lights are required for the navigation of Galveston bay; and their relation to each other is shown on the annexed chart by the positions marked "Half-Moon shoal," "Red Fish bar," and "Clopper's bar." The detailed charts show the locations more particularly of the lights at Clopper's bar and Red Fish bar, and the character of the navigation of the bay, the purposes of which they are to subserve. For details in regard to the lights I refer to the report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, which accompanies this report.

I concur with Lieutenant Craven in recommending a light-house as placed on the chart, at Clopper's bar; also in recommending a light-house placed as on the chart, at Red Fish bar. I am of opinion that the sites at Red Fish bar and at Half-Moon shoal should each be examined by a competent engineer, in reference to the doubts expressed by Lieutenant Craven as to the stability of the foundation, or that an ade-

quate guarantee should be obtained to secure the government against loss should a contract be made for the construction of these light-houses. If this examination, which should be accompanied by borings to ascertain the character of the substrata, should prove satisfactory in its results at either of the sites, or if an adequate guarantee should be obtained in regard to the structures, then I would recommend the construction of a light-house on screw piles at Red Fish bar, and at Half-Moon shoal. While the reasons given by Lieutenant Craven for placing a light-boat near Half-Moon shoal, instead of a light-house, show that caution is necessary, they are not, in my mind, conclusive against the construction of the light-house, as the shoal appears to be composed of sand and shells, and is in the interior of the bay.

Solid structures, which will obstruct the water way, are not at all adapted to the two upper positions in the bay.

The lights should be all of the harbor class. A small, fourth-order bay-light will suffice for each. The "light-houses" are required by law to be of the "third class." The lights need not be more than sixteen feet above the surface of the water to answer the purposes required of them.

Lieutenant Craven recommends the placing of a buoy off Dollar point, for which there is no appropriation yet made.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. WM. L. HODGE,

Acting Secretary of the Treasury.

Report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, to the Superintendent, in relation to light-houses in Galveston bay, Texas.

UNITED STATES SCHOONER MORRIS,
Galveston Bay, May 13, 1851.

SIR: In obedience to your instructions of April 2, I have made an examination of Clopper's bar, Red Fish bar, and Half-Moon shoal, and send you a sketch of the bars on a scale of $\frac{1}{40000}$.

Half-Moon shoal I have laid down on a general chart of the bay of $\frac{1}{200000}$. As there is already a considerable trade carried on with the upper part of the bay, lights are very much needed at each of these points. I have to report as follows:

1st, Clopper's bar. At the mouth of San Jacinto river, on this bar, I found 4.5 feet, and it is situated at a point where the channel makes a very short bend. The bar is short, and of hard sand, a quicksand, liable to occasional shifts. I would recommend that a light of the third class be placed on the point of the sand spit, which I have marked "Light." At this point it would guide vessels clear of the shoal, making off from Mesquit knoll, and would also indicate the turn in the channel, as it should be situated so that vessels might pass it close on their port side.

The light-house should be built on iron piles, well sunk beyond the sand.

From this place to the Red Fish bar there are no obstructions, the soundings being very regular, eight and nine feet.

2d, Red Fish bar.—At this place a light is of such importance that there has been one placed here by private enterprise—the trading vessels paying an annual subscription. The light stands on the key indicated in the triangulation as “Middle Pass.”

I would suggest that a light be placed on the east end of a small key, situated about two hundred and twenty metres ESE. of the present light. As you will perceive by the chart, a better range can be had for running through the channel than at present. On this bar there are at low tides 4.5 quicksand. There is better water in the channel SW. of the light-house, but the channel is so crooked and so very narrow that it is rarely used. The light-house on Red Fish bar should be on iron spikes, sunk to a good depth; and if the light has an elevation of twenty-five feet it will be quite sufficient.

The light at present there is not elevated more than eighteen feet above the water. I have made an examination of a shoal off Dollar point, on which there are three and a half feet water, and would suggest that a buoy be placed on its east side, in nine feet, which will give muddy bottom.

3d, Half-Moon shoal lies directly in the channel principally used by trading vessels and steamers; and I have found on it *one foot*. It is of small extent, and has a channel between it and the shore of *seven feet*. East of it the water is nine and ten feet, and very regular. This bank is composed of sand and *shells*. I would recommend that at Half-Moon shoal a small light-vessel be placed; a common bay sloop of forty tons would be sufficient. She should be coppered, as the worm is very destructive here; and her anchor should have but one fluke. She should be placed in ten-feet water, to the eastward of the shoal. The light placed at an elevation of twenty feet above the deck would be sufficient; and lights for each of these should be of the third class.

I recommend a light vessel at this shoal, as it is my belief that a light-house built here would be undermined by the current, and the sand, thus cut away, deposited in another place, thus rendering the light useless. I believe, too, that the same difficulty will be encountered in a permanent structure at Red Fish bar, where changes frequently take place, but am not prepared to say whether the substratum will give sufficient stability to the piles. I can best illustrate my meaning by calling your attention to the fact that the steamer wrecked in the channel several years ago (and the position of whose cylinder is given on the chart) was originally in five-feet water; the tides have cut away the sand to about twelve feet, all about the wreck.

Very respectfully, your obedient servant,

T. AUGS. CRAVEN,

Lieutenant Commanding, Assistant U. S. Coast Survey.

Professor A. D. BACHE,

*Superintendent United States Coast Survey,
Washington.*

APPENDIX No. 39.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury, recommending a light-boat and buoy at Aransas Pass, and transmitting the report of the examination, by Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey.

COAST SURVEY STATION,
Mount Pleasant, Maine, July 17, 1851.

SIR: I have the honor to report, in conformity with the law approved March 3, 1851, and the instructions of the department, that the examination of the necessity for a light-house at Aransas pass, Texas, has been made, and I enclose, herewith, the report of Lieutenant Commanding T. A. M. Craven, United States navy, assistant in the coast survey, the officer by whom the examination has been made, with the accompanying sketch of a reconnaissance of the locality.

It appears clearly, from this report, that the facility to navigation proposed in the appropriation bill is not "most suitable for the exigency which exists," but that it is expedient to place a light-boat of forty tons, with a harbor-light apparatus, instead of the light-house. Such a light-boat will subserve both the general and local wants of trade and navigation, and its position can be changed to accommodate it to the changing character of the entrance. The boat can be securely moored. I therefore recommend a suitable light-boat for Aransas pass, instead of the proposed light-house.

I would respectfully call the attention of the department to the fact stated by Lieutenant Commanding Craven, that there are no buoys in Aransas pass; also his views in relation to the position of the Galveston light-boat.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. States Coast Survey.

Hon. WM. L. HODGE,
Acting Secretary of the Treasury.

UNITED STATES SCHOONER MORRIS,
Galveston Bay, June 21, 1851.

SIR: By the extraordinary inclemency of the season, I have been delayed in the examination of Aransas pass (as required by your instructions of April 1) until the last week.

I now enclose you my sketch of the pass, and have to report as follows: From the frequent and rapid changes of the bar, (which I will indicate in this report,) I am of opinion that a light-house cannot be built at this place, in a suitable location, with any certainty of its standing five years.

The point in my reconnaissance, designated as "old range," was, in 1846, *within one hundred and twenty yards of the channel*, and the "range" itself was a wash. It is now three hundred and fifty metres from the

beach, and upwards of half a mile from the main channel. The "capstan" was planted in 1849 for heaving off a vessel which had grounded in this channel.

The point I have marked as "E range," was formerly a pilot's range, and fifteen months since was about fifty yards from the beach in the channel way; it is now three hundred and forty metres from the beach.

You will see from the above, that the point of St. Joseph has, for years, been making rapidly out to the southward, and as it encroaches on the channel, the opposite point of Mustang island wears away with equal rapidity. All of the point of St. Joseph, from the "old range" to the spit at the narrows, is a loose sandy flat, which has been entirely formed since 1846, and on which vegetation has commenced. I found an unusual depth of water on the bar— $9\frac{1}{2}$ to 10 feet—which may be accounted for by the strong and continued southeast winds of this season; ordinarily there are from 7 to 8 feet. The harbor is a good one, and is a place of some little coasting trade, there being one or two settlements up the bay.

I consider it of more importance as a *harbor of refuge* than as one of any present commercial advantage, and am of opinion that a light is very desirable at this place. A small light-vessel of *forty tons* and light draught may be anchored inside the south breakers, in $2\frac{1}{2}$ fathoms, in good holding ground, and well sheltered from any storms, the bar forming a complete breakwater. A light of fourth class will be sufficient. The vessel should be well coppered.

I have to report that the buoys, which were placed on the bar, not having sufficient *chain*, have long since parted and gone adrift. There are at present no channel marks whatever.

The soundings on the sketch are expressed in *feet*, as there is much irregularity of bottom. I have thus guarded against mistakes.

The breakers are long spits of sand which are constantly changing with every storm, so that ranges for running in are altering every five or six months.

In connexion with this subject I have to report, that after a careful examination of the matter, I may say, confidently, that the light-ship at Galveston, in her present location, is of scarcely any use to sea-going vessels. She is anchored nearly *three miles inside the bar*, and knowing the approaches as well as I do, I consider it unsafe to run for it at night, because of the difficulty of seeing the light at a safe distance outside; and, in consequence, a sailing vessel not "having hold of the light," cannot ascertain her position, and having no guide to her movements, is liable to be swept to the southward and westward by the current.

I know that it has been urged that the present location of the light-vessel is of great advantage to coasters, as being at the junction of the three channels.

The coasting trade, however, is small, and is carried on in vessels not exceeding four or five feet draught. These vessels alone, save one or two steamers of light draught, use the south channel; they could, most of them, run over any part of the shoal forming the bar without danger; the sea steamers use the main channel; the north or cylinder channel is only used by two or three small craft trading with the Sabine,

and which might safely pass anywhere over the shoals. These coasting vessels, therefore, hardly require a light, particularly where, in giving it to them, the interest of the external commerce suffers.

Very respectfully, your obedient servant,

T. AUGS. CRAVEN,

Lieut. Com., Assistant U. S. Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 40.

Tribute of respect to the memory of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey.

Intelligence having reached Washington city of the death, at Panama, on the 22d December last, of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey, the civilians and officers of the army and navy on coast survey service met at the office on Wednesday, February 8, 1851, to pay the tribute of respect due to his memory.

The meeting being called to order,

On motion of Lieutenant Chas. H. McBlair, United States navy, seconded by Lieutenant Maxwell Woodhull, United States navy, Alexander Dallas Bache, LL. D., Superintendent, was called to the chair, and Lieutenant Thornton A. Jenkins, United States navy, appointed secretary.

Professor Bache addressed the meeting as follows:

We are met here, as you all know, to pay a melancholy tribute of friendship and respect to one who was dear to us all—dear as a brother to many of us. Instead of greeting his arrival among us, as we had fondly hoped, in health—in the full flush of success—we meet to mourn over his loss from our band.

The work which he accomplished will live forever. Surrounded by circumstances the most difficult, perhaps, which ever tried the constancy, the judgment, the resources of any hydrographer, he vanquished circumstances. His reconnaissance of the western coast, from Monterey to Columbia river, and his preliminary survey there, were made in spite of desertion and even mutiny—in despite of the inadequacy of means to meet the truly extraordinary circumstances of the country. Happy that in his officers he had friends devoted to him and to their duties—especially happy in the officer next to him in the responsibilities of the work.

Prostrated by an attack of fever of a malignant type, contracted while preparing his vessel for sea, Lieutenant McArthur, nevertheless, persisted in volunteering for the charge of a hydrographic party on the western coast. A subsequent relapse did not abate his determination to enter as a pioneer upon this arduous service—trying alike to his powers of mind and body. Steady in the midst of excitement, he laid his plans in the way to command success. Seizing the peculiar wants of the hydrography of that coast, he applied all his energies to supply

them. The gratitude of his fellow-citizens, then, is already his—the praise of the new country, the resources of which he has aided in developing. He has been called away just as his wishes were realized, ample means furnished, and the worst difficulties overcome. In his letter and report he urged strongly the necessity for enlarged appropriations, and for a steam vessel for the hydrography. The last letter from this office brought him news that both his wishes were gratified, and called him home to make the enlarged arrangements for continuing his work. The arrival of Mr. Cutts, with instructions as late as the beginning of October, confirmed the necessity of his return, and he took passage in the steamer Oregon, commanded by his friend, Lieutenant Patterson. An attack of dysentery prostrated him completely, and from this, in spite of the best medical attendance—of such nursing and attendance as only the circumstances to which I referred could insure—he rallied but for a time, and sank to his final rest before he could be landed at Panama. His remains were consigned to a foreign soil, to be brought, let us hope, to his country, where all his affections centred.

He has not lived in vain. His name will ever be bright in the annals of our survey—whether in the more usual labors on the Atlantic coast, or as the pioneer on the shores of the Pacific—always advancing as life advanced—the last his crowning work.

Professor Bache having concluded his remarks, Lieutenant Washington A. Bartlett, United States navy, arose and said—

Mr. Chairman and gentlemen: After the appropriate and feeling remarks of the chairman, it is unnecessary for me to add more than to say that when I left Captain McArthur on the western coast he was in excellent health and buoyant spirits, in view of what had been done, and what he hoped yet to accomplish. It was my good fortune to be long associated with him, and that association caused me to love him as a brother. I will not detain you, but offer the following resolutions for your consideration:

1. *Resolved*, That the civilians and officers of the army and navy engaged in the United States Coast Survey, now assembled in Washington, have received, with feelings of deep emotion, the melancholy intelligence of the death of Lieutenant Commanding Wm. P. McArthur, United States navy, assistant in the coast survey; and that, in his sudden and unexpected decease, the navy has lost one of its most gallant and accomplished officers, and the coast survey one of its most zealous and efficient laborers.

2. *Resolved*, That the successful reconnaissance of the western coast of the United States, from Monterey to Columbia river, and the preliminary survey of the entrance to the Columbia—accomplished under the most peculiar and extraordinary difficulties—while they are proofs of his unconquerable energy, determination and skill, have forever identified the name of Wm. P. McArthur with the progress of the republic in the West.

3. *Resolved*, That we most sincerely sympathize with the bereaved and afflicted family of our generous and warm-hearted friend in their irreparable loss, and commend the widow and orphans to the gratitude of the republic, to whose service the husband and father was so ardently devoted throughout his life.

4. *Resolved*, That Professor A. D. Bache, Superintendent United States Coast Survey; Brevet Major J. J. Stevens, United States Engineers; Lieutenant M. Woodhull, United States navy; Mr. J. J. Ricketts, United States Coast Survey; and Passed Midshipman R. M. Cuyler, United States navy, be a committee to take the necessary measures to have erected, in the Congressional Burying Ground, a suitable monument, commemorative of the services and virtues of the deceased.

5. *Resolved*, That a copy of these resolutions be communicated to the Navy and Treasury Departments, with a request that they be placed on the files; and also to the family of the deceased; and that they be published.

6. *Resolved*, That the officers of the coast survey will wear a badge of mourning for thirty days, in further testimony of their regard for the memory of the late Lieutenant Commanding Wm. P. McArthur.

Major Stevens, in seconding the resolutions, addressed the meeting as follows:

I rise, Mr. Chairman, in the name of one of the co-ordinate services associated on duty here, to pay a tribute to the memory of Lieutenant McArthur. I can add nothing to the remarks that have already been made. I simply propose to pay a tribute of feeling and respect.

It was not my fortune to know Lieutenant McArthur personally, but I feel that I know him through his works. They hold up his character as worthy of all respect and admiration. In prosecuting his labors on the Pacific shore, he exhibited a constancy, an energy, and a rare force of command, which enabled him to triumph over almost insuperable difficulties. These qualities would have made him conspicuous in any career. He possessed all the elements of the heroic spirit. Trials which bowed down the strength of strong men, gave his feeble frame almost superhuman strength; and he accomplished, in the midst of sickness and physical depression—of mutiny and desertion—labors that those most highly favored by health and appliances would have shrunk from. His example appeals to us with irresistible force. How can we yield to despondency, witnessing his lion heart accomplishing its great purposes—giving vigor to a worn-out frame, and snatching success from the elements of defeat.

McArthur was an ornament to both services with which he was connected—to that larger service, the profession of his youth, in which he took such pride, and that other service, to which his maturer years have been applied. He has, in the words of the resolution, forever identified his name with the progress of the republic in the West. It has gone into history, and will henceforth be associated with those of Decatur and of Perry.

The resolutions having been agreed to unanimously, the meeting adjourned *sine die*.

A. D. BACHE, *Chairman*.

THORNTON A. JENKINS, *Secretary*.

APPENDIX No. 41.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, showing the most suitable site for a light-house at Point Conception, California.

COAST SURVEY OFFICE,
March 13, 1851.

SIR: I transmit herewith a sketch of Point Conception, California, furnished by the officer of the coast survey on that coast, for the purpose of showing the most suitable site for a light-house in that vicinity.

This is a steep, rocky point, projecting into the sea, 240 feet high; at the point selected for the site of the tower 286 feet broad, 533 feet to the pitch of the point; and the whole length of the projection 832 feet.

It has been ascertained, by a careful examination and inquiry, that the point Arguillo, to the northward, is not the best location. All who have been consulted on the subject agree in recommending the point marked on the sketch $\odot$ as the best position for the light. It will be seen from the accompanying tracing of the coast of California, on either side of Point Conception, that it *trends* about NW. and SE. A first-order seacoast light, with a lantern thirty or forty feet from the base of the tower, will be seen, under ordinary circumstances, twenty-five to twenty-eight nautical miles from the deck of an ordinary merchant vessel.

It is deemed highly important that this should be a light of the first order, according to the European classification, illuminating two hundred and eighty degrees of the horizon, to subserve all the purposes of navigation.

The light on Point Conception should be made a revolving or flashing light, to enable the proper distinctions to be made in those on either side, and nearest to it.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOS. CORWIN,
Secretary of the Treasury.

 APPENDIX No. 41, *bis*.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury, on the latitude and longitude of Point Conception, California.

COAST SURVEY OFFICE,
March 22, 1851.

SIR: The latitude of the coast survey station at Point Conception, California, has been determined from observations by Assistant George

Davidson, to be $34^{\circ} 26' 56''$ north, and the longitude $120^{\circ} 25' 6''$, or in time 8h. 01m. 43s. west of Greenwich Observatory.

Yours, very respectfully,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

APPENDIX No. 42.

Letter of Superintendent of Coast Survey to Secretary of Treasury, communicating a report of A. M. Harrison, esq., sub-assistant in coast survey, on a site for a light-house on Point Pinos, near Monterey, California.

COAST SURVEY OFFICE,

March 14, 1851.

SIR: I have the honor to transmit herewith a sketch of Point Pinos, near Monterey, California, the site recommended in the accompanying report for the light-house near Monterey, for which an appropriation was made at the 1st session of the 31st Congress. I concur in the recommendations contained in the report. The choice of the site, between the three points designated, might be left to the engineer charged with the construction of the light-houses.

Very respectfully, yours,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

CAMP, POINT PINOS, NEAR MONTEREY, UPPER CALIFORNIA,

January 28, 1851.

DEAR SIR: This report accompanies a tracing of the plane table map of *Point Pinos*, including the extreme end of the point and the vicinity towards Point Cypress on one side, and Monterey on the other, on a scale of $\frac{1}{10000}$. It gives the ground in the region of the most suitable position for a light-house, showing its character, elevation, &c.

Point Pinos is a pine-covered, rock-bound projection of land, extending in a NW. direction from Monterey to the distance of about three miles, rising gradually from the water's edge, and, from its position, affording complete shelter from the SE. winds to vessels at anchor off the town. The whole shore of the point from near Monterey to Point Cypress is very rocky, and, except in the calmest weather, there is a heavy surf from the swell of the ocean, rendering a landing in the boats exceedingly dangerous, if not impossible.

I have marked upon the tracing three positions, (*a, b, c,*) in each of which a light-house may be placed, each having its advantages.

(a) as shown in the tracing, is in the pines, its advantage over the other two being its elevation; but, in order to be seen to the seaward, and by vessels leaving the harbor, it will require a great deal of clearing. The ground is sandy and pretty firm.

(b.) This position is in the small sand-hills. The site commands a fine view to seaward, and requires little if any clearing.

Judging from the nature of the point, it is to be presumed that beneath the sand there is a rocky substructure for a foundation, although it may be at a considerable depth.

(c) is the level surface of the rocks, covered with wild shrub. Its foundation is good, but it is cut off from the main shore at high-tide; the distance being 103 metres (112.6 yards.) The islet is about 80 square metres (95 square yards) in area, and about ten feet above high-water mark. The main objections to it, as a site for a light-house, consist in its small size, its isolation from the main-land at high tide, and an uncertainty as to how long it will stand the force of the sea. It is exposed to the full violence of all seaward winds, and many of the rocks in the vicinity have been undermined and have fallen. It is also possible that in severe gales the sea washes over it.

The distance at which the light from the lantern of a light-house 40 feet in height would be visible if placed on

(a) would be.....	13 miles.
(b).....do.....	11 "
(c).....do.....	9 "

The sector of visibility of the light from seaward would be 110° from the south, round through the west, to north.

The line (x) shows the general run of the shore towards Monterey, and (y) towards Point Cypress.

I have before spoken of the difficulty of landing on the point, but the town is only about three miles distant, and there is a good road running to the end of the point.

Fine spring-water can be obtained in the immediate neighborhood, and the land is sufficiently rich for the purposes of cultivation almost anywhere on the western side of the point.

There is a quarry of coarse limestone near the town, but whether suitable for building purposes or not I am not informed.

If it is proposed to erect a fog-signal here, (and the fog is very frequent and thick in the winter,) there are many places on the rocks equally suitable for the purpose, as may be seen by a reference to the map. I have inserted the true and the magnetic meridian—the former given me by Assistant Davidson, and the latter obtained approximately by the compass attached to my plane table.

Very respectfully, your obedient servant,

A. M. HARRISON.

Sub-Assistant U. S. Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 43.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, recommending a light-house at Point Loma, near San Diego, California; with the report of Sub-Assistant A. M. Harrison on the same.

COAST SURVEY OFFICE,
November 22, 1851.

SIR: In conformity with the instructions of the Treasury Department, I have caused a survey to be made for the sight of a light-house at Point Loma, near San Diego, California, for which an appropriation was made by act of Congress approved September 28, 1850. I send herewith a sketch, showing the locality proposed for the light, and its relations to the harbor of San Diego and its approaches; also, a sub-sketch, on a large scale, giving the character of the site more in detail. In a few weeks an engraved harbor chart of San Diego will be transmitted, to take the place of these sketches, or as supplementary to them.

The light which is recommended is one of the first order, or a sea-coast light, to be placed on the bluff in the position marked, in a tower (say) twenty feet high. The range will thus be 31.7 statute miles, and the light will be visible beyond the Coronados, and over a sector of the horizon of about 187° .

A small harbor-light is further recommended on Ballast point, at the place marked in the sketch, as a leading light up the bay. Its elevation may be fifteen feet.

I append the report of Sub-Assistant A. M. Harrison, by whom the plane table survey of Point Loma was made. The survey of the harbor was made by Assistant R. D. Cutts, of the coast survey.

The considerable height of the point at which this light-house is to be placed induced me to withhold the report of Mr. Harrison, and any recommendation concerning it, until I had consulted him as to the probability of interference from fog. He reaffirms his opinion of the propriety of the site, after considering this objection.

In recommending lights for the western coast, I have not advised that any of them be revolving lights, except in the case of Point Conception, conceiving that at present, until facilities for repairs of machinery and the number of lights are increased, it is inexpedient and unnecessary to resort to such a distinction.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

HON. THOMAS CORWIN,

Secretary of the Treasury.

LA PLAYA, NEAR SAN DIEGO, CALIFORNIA,

June 2, 1851.

DEAR SIR: This report accompanies a tracing from the plane table map of the bay of San Diego, including Point Loma, the proposed

light-house site, and La Playa, (the *port of San Diego*,) on a scale of $\frac{1}{10000}$.

Point Loma is a long, narrow strip of land, extending in a southerly direction about $2\frac{3}{4}$ miles from the Playa, and is composed of a chain of abrupt and broken hills, varying from 200 to 400 feet in height, cut with deep, narrow, and in many places precipitous gorges. On the western side the shore is perpendicular, and varies from twenty-two to ninety feet in height; while on the eastern shore of the Playa to Ballast point, (a narrow low spit, formed of large pebbles, running out from Point Loma, and forming the western side of the entrance,) the shore is bluff, and not generally as high as the opposite one. To the south of Ballast point the shore is still bluff, and increases gradually, until it reaches the extreme point. At this place the hills jut boldly upon the sea, forming a very steep bluff, three hundred feet in height. The hills are composed mainly of coarse modern sandstone, and are covered with a growth of low bushes, red wood, and artemisia, interspersed with three or four varieties of cactus. Landing is practicable, in calm weather, at almost any part of the point; but the hills are so precipitous that it would be almost impossible to transport any building materials up their sides.

The position for a light-house, which I have marked upon the chart by a red circle, I recommend for the reason of its superior elevation, the large view it commands to seaward, its good foundation, and its level surface. It is four hundred and twenty-two feet high.

The distance at which the rays of light would touch the horizon of the ocean from a light-house twenty feet high, located at this site, would be thirty-two and four-tenths statute miles.

It commands an extent of horizon to seaward of 187° . In erecting a light-house on this point, the materials should be landed at the Playa, and then could be easily carried to the point along the top of the range of hills. There is a path extending the whole distance, and, with a little cutting of the bushes, it could be made practicable for mules. It would be necessary to bring the materials for building purposes from some other port, as there is nothing in this region which could be turned to advantage.

There is no water nearer than San Diego, five miles distant from the Playa. It is obtained from San Diego river, and brought down in casks. Some men are at present boring an Artesian well at the Playa, but success is very doubtful. The land is not favorable for cultivation.

The entrance to the bay is so narrow, and Ballast point is so low, that I think a secondary light on the end of it would be advisable. The extremity of the point is composed of large, round pebbles, similar to our paving stones, and the foundation is quite hard. I have marked the point upon the tracing.

Since our stay here, fogs have been frequent and heavy, and I think it would be advisable to place a fog-signal upon the bluff at the end of the point. If it is to work by the action of the waves, it could be

placed upon a reef running S. by W. from the end of Point Loma, where there is always a swell, even in the calmest weather.

Respectfully submitted.

A. M. HARRISON.

Professor A. D. BACHE,

Superintendent United States Coast Survey.

APPENDIX No. 44.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of Sub-Assistant A. M. Harrison, of a survey of Cape Disappointment, or Hancock, for location of a light-house, and communication of Lieutenant Bartlett, U. S. N., assistant in coast survey, on same subject.

COAST SURVEY STATION, NEAR ALFRED, ME.,

September 29, 1851.

SIR: I have the honor to transmit, in pursuance of the instructions of the department, a minute survey of Cape Disappointment, or Hancock, at the entrance to Columbia river, Oregon, for the location of the light-house for which appropriations have been made. To the report and sketch of Assistant A. M. Harrison I add a proof-sheet of the preliminary survey of the entrance, to show in a general way the localities referred to. I have also annexed a report by Lieutenant Bartlett, U. S. navy, assistant in the coast survey, in relation to this same light, which contains suggestions in reference to the kind of structure to be erected there. I approve the recommendations of Assistant Harrison of the site marked © on his map for the light-house, and of the elevation of forty feet, which he proposes for the light. It should be a seacoast light of the first class, and will be visible nearly twenty-five miles.

I would recommend that so much of the adjacent woods should be removed as will render the establishment secure from the near approach of fire.

Very respectfully, yours,

A. D. BACHE,

Superintendent U. S. Coast Survey.

HON. THOMAS CORWIN,

Secretary of the Treasury.

U. S. COAST SURVEY STATION, CAPE HANCOCK,

Mouth of Columbia River, Oregon, July 28, 1851.

DEAR SIR: I send with this report a tracing of Cape Hancock, or Disappointment, on a scale of $\frac{1}{10000}$. It embraces the proposed light-house site and three miles of the shore. Cape Hancock, forming the northern point of the entrance to Columbia river, is a bold, narrow promontory of basaltic rock, projecting into the sea in a curve from the north around by the west to the south.

The extremity of the cape is formed of a range of hills, varying from one hundred and fifty to two hundred and eighty feet in height, generally narrow at the summits. On the outer faces these hills are covered with rank, high, thick grass and weeds, and slope abruptly to different heights; then, falling perpendicularly, present to the ocean an irregular wall of rock, intersected at one or two points by deep inlets, into which the sea flows during flood tides. On the inner side the slope is more gradual, but in most places also steep, and from the top of the ridge down to the water's edge, covered with tall pines, and a dense and occasionally impenetrable undergrowth of bushes; the *salmon berry*, fern, and *salal* being the principal kinds. The soil is rich, and covered to the depth of a foot, and in some places more, with a light, yielding carpet of decayed and decaying leaves and branches, the annual deposit of the trees and bushes above.

The cape forms the western shore of Baker's bay, which affords good anchorage in six and three fathoms.

The position which I think most advisable for the location of a light-house, and which I have marked upon the tracing by a black circle, I recommend for the following reasons:

Height. Although ninety-five feet lower than the hill upon which the observatory is situated, (which is the highest on the end of the cape,) I think it has the advantage from the fact that the fog banks, during their prevalence, frequently, and in fact generally, rest upon and above the summits of the most elevated hills; while those below are clear and unobscured. So I am informed by persons who sail in and out of the river. Light-house hill is one hundred and ninety-two feet high; Observatory hill two hundred and eighty-seven feet.

Command to Seaward. The angle commanded to seaward by a light placed as recommended would be much greater than one on Observatory hill, unless the government chose to go to the expense of time and money in felling a large quantity of trees to the northward, and those, like all trees of Oregon, of no ordinary size. A person standing on the proposed site commands a view to seaward of one hundred and thirty four degrees.

Form. Upon the summit it is broader, and would require less digging and grading to secure a sufficiently large foundation. In fact a light-house could not be erected upon the narrow top of Observatory hill without a great deal of trouble and expense on this account. In digging I find stone at the depth of two feet.

The best point at which to land materials for building purposes is the little cove I have marked ("a") upon the tracing. A road which was cut for carrying up the observatory would suffice to get upon Observatory hill; but the path between the Observatory and Light-house hill runs along a narrow ridge. I have marked it upon the tracing by a black line. I think it would be advisable to cut a road directly from the cove to Light-house hill, a distance of about 440 metres (481 yards.)

The cove ("a") in which our camp is pitched is a good position for a house, being, by the present path, fifteen minutes' walk from Light-house hill. A spring of fine water runs in a continual stream from the rocks, a few metres from camp, and there is sufficient ground for a

small vegetable garden. A house once stood here, but was destroyed by fire.

The site for a city has been laid out about two miles from the point, under the title of Pacific city.

The house which you see upon the tracing was erected by the Hudson's Bay Company, and is occupied by a half-breed and his family. He has quite a good garden.

The distance at which a light, forty feet high, located at the site, would be visible, is twenty-five statute miles, nearly.

Respectfully submitted by your obedient servant,

A. M. HARRISON,

Sub-Assistant Coast Survey.

Prof. A. D. BACHE,

Sup't U. S. Coast Survey, Washington.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in coast survey, to the Superintendent, in relation to a light-house at Cape Hancock, or Disappointment, entrance to Columbia river.

WASHINGTON, November 29, 1850.

SIR: In answer to your inquiries as to the character of the light-house which should be erected at Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, and for information as to the locality on which it should be placed, &c.—

I have the honor to state, that Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, where it is proposed by a late act of Congress to erect the principal light-house for that river, is a bold cliff of columnar basalt, rising perpendicularly from the sea to variable heights of from two hundred to three hundred feet, terminating in unequal rolling summits, covered with a rich and fertile soil.

The summits vary also in width from ten to fifty feet at the apex, whence they slope by a quick descent to the northward; the northern or in-shore face of the hills being covered by a dense growth of gigantic pine, alder, and other trees, with a thick growth of vines, "salmon berry," and other shrubbery.

The summit of the sea cliffs (which are not covered by the forest) is the proper position for locating the light-house; say within two to four hundred yards to the westward of "Broom station," as given on our triangulation of the river. Should the tower be placed there, it will show the light from the lantern around three-fourths of the horizon without the necessity of felling the trees to the northward.

In this position the base of the tower will be about two hundred and fifty feet above high-water mark; and should the tower be raised forty feet to the deck of the lantern, (and in my opinion it should not be less,) on a base of sixteen feet in diameter, it will be a prominent landmark for making the cape in the daytime.

The lantern, or light, which is to be placed on the tower should be of a power not less than the best light on Navesink; in other words, a marine light of the first power.

The tower should be constructed of fire-proof materials, and no wood whatever should be admitted into the construction of the building, as there is at all times much danger of the forest being fired to the northward, which, in such case, would inevitably destroy the building.

From the cove in Baker's bay, where the materials would be landed, the distance is about one thousand yards by a path, now greatly obstructed by huge trees, which have fallen across it. It must ever be a difficult matter to transport any great amount of bulk, or weight, to the summit. A good road must first be made. Whether the tower is constructed of wood, iron, or brick, the materials must be transported in small parcels.

When such a tower as I have contemplated is lighted up by a light of the first power, it will be clearly visible for a distance of nine leagues at sea, from the northwest by the west, and southwest to the south, and by the east for the entire width of the river, and for the same distance up the Columbia.

A light on Cape Hancock, or Disappointment, will be of vast importance to the rapidly increasing commerce of Oregon, as it will enable all vessels to approach the coast boldly, and then to maintain their positions on pilot-ground until daylight, when they will be at once taken into port by the highly intelligent pilots now fully established there.

Very respectfully, sir, I have the honor to be your obedient servant,

WASHINGTON A. BARTLETT,

Lieutenant United States Navy, Assistant Coast Survey.

Prof. A. D. BACHE,

Sup't U. S. Coast Survey.

APPENDIX No. 4.

Extracts from a letter of Lieutenant Commanding James Alden, U. S. N., assistant in the coast survey, to Professor A. D. Bache, Superintendent, relating to Humboldt harbor and Trinidad bay, California.

U. S. SURVEYING SCHOONER EWING,

San Francisco, August 31, 1851.

DEAR SIR: * * * * * *

We left San Francisco on the 24th of June, and after an exceedingly boisterous passage of ten days arrived at Trinidad. This anchorage is, during six months of the year, perfectly safe and comfortable. It is some twenty miles to the northward of the entrance to Humboldt; and, as the wind was unfavorable for us to go there at the time, we employed ourselves during the detention of two or three days in making a chart of the bay. It is sent with the others, and I hope it will meet with your approbation. The mines in the vicinity of Trinidad have made it quite an important location. It serves as a resting place for the miners, and is the source whence all their supplies are derived.

There are about one hundred houses in the village, and the land in the vicinity, for agricultural purposes, can hardly be surpassed. The

gigantic red wood abounds there in all its magnificence, always affording to the hardy settler the readiest and most lasting material for neat and appropriate buildings. The fibre of this wood is so straight, and so easily separated, that it is split with comparatively little trouble into all the different forms requisite for an unpretending dwelling in a new country. The depredations of the Indians in that quarter have been, I am sorry to say, a serious drawback to their farming operations; so much so, indeed, that most of them have been compelled to leave their all and go into the town for protection.

On the 10th July we left Trinidad with a fair wind, and in a few hours were at anchor in Humboldt bay. We were employed about four weeks in making the survey of that place. Finding it much better in every respect than it had been represented, I gave it more care and made a closer examination than an ordinary reconnaissance required.

* * * * *

This body of water partakes more of the character of a lagoon than an ordinary bay. It is sixteen miles long, and from one to five broad. It is broadest at either extremity, where it is but a great grassy flat, washed with about one foot of water, (when the tide is out,) and broken here and there by navigable sluices. The entrance is practicable, except in very bad weather, when the sea breaks entirely across it. There are twenty-one feet on the bar at low water, and the ordinary strength of the tide does not exceed two knots. Under unfavorable circumstances, at low water, and with a very light breeze blowing directly in the channel, this schooner went to sea without difficulty. The two sea walls, or narrow necks of land, which so nearly shut out the sea, are covered with sand-hills, ranging from ten to forty and fifty feet in height. On the north spit I have marked the place where I think the light-house should be located. It is the nearest point to the entrance, and is, therefore, less liable to be obscured by fog; and with a beacon farther back, the two would form the best range to pass between the north and south breakers—not that it should be attempted at night, unless under the most favorable circumstances. As Humboldt is rather out of the way of vessels passing up and down the coast, I have thought that a light of the second or third class would answer all purposes required at that point, and be sufficiently large for vessels bound in to maintain their position during the night. The country is hilly, almost mountainous, in the vicinity of Humboldt. The fir and the red wood predominate in the forests, and I am informed that the land possesses every requisite for farming purposes. The cattle luxuriate the year round in green grass and the tallest clover I ever saw. The temperature is very equable; they have a slight frost in the fall, and the winter only differs from the summer in being more pleasant. Elk and deer are found in abundance, and many varieties of wild fowl frequent the bay. There are no less than four villages or settlements on the bay. Humboldt, at the entrance, has thirteen houses; Eureka as many. Bucksport is just taking a start, and its location is thought to be superior to all the others, from the fact that it has better water and more room for commercial purposes. Union town is the largest, having about one hundred houses. It is located in the north end of the bay. Its proximity to the mines is the only advantage it has over the others

while the difficulty of transporting supplies from the depot at Eureka seems to be almost an insurmountable objection to its ever becoming a place of much importance. Everything has to be carried in small boats up a very narrow sluice, and that only at high water, while the nearest point of water communication is a mile from the town. A road can be cut from either of the other towns to communicate with the one from Union to the mines, with but little expense or trouble.

I am, sir, very truly and respectfully, yours, &c.,

JAMES ALDEN,

Lieut. Com'g. U. S. N., and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 46.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of R. D. Cutts, esq., assistant in the coast survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses.

COAST SURVEY OFFICE,

February 13, 1851.

SIR: I have the honor to transmit a report by Assistant R. D. Cutts, of the Coast Survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses in the bill passed at the last session of Congress. The complete drawings which Mr. Cutts forwarded by Adams & Co.'s express have not come to hand, but the report and sketches of the sites, with a tracing from the chart of the bay, which shows the relative positions of the points, will supply the information essential to the action of the department. When the complete drawings are received, I will replace these and sketches by copies of them.*

I have examined, and confirm, the recommendations made by Mr. Cutts in his report; nor have any facts come to my knowledge from inquiries made of Lieutenant Patterson, United States navy, formerly attached to the Coast Survey, who has commanded the mail-steamer Oregon, plying on the western coast, of Lieutenant Bartlett, recently engaged in the hydrography of the western coast, and of Passed Midshipman McLane, second officer of the mail-steamer "Panama," and recently attached to the Coast Survey, to indicate that the location already adopted for lights at the entrance of San Francisco bay (the South Farrallone, Fort Point, and Alcatraz island) should be altered.

I respectfully recommend for the light on Fort Point one of the sec-

* The drawings were subsequently sent in.

ond order, (French system,) or its equivalent; and for the one on Alcatraz island one of the fourth order, or its equivalent.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOS. CORWIN,
Secretary of the Treasury.

SAN FRANCISCO BAY,
December 27, 1850.

DEAR SIR: In conformity with your instructions of October 5, directing that light-house surveys should be my first and immediate duty upon arriving at San Francisco, I have to report that I have made the necessary examinations and surveys of Alcatraz island and Fort Point, in the Bay of San Francisco, the results of which, and sketches on a scale of $\frac{1}{10000}$, are herewith forwarded.

The magnetic course of Alcatraz island from Fort Point is N. 53 E., say NE., by E. which is the best range for crossing the bar and for passing between Points Lobos and Boucta. The Farrallones are visible from Alcatraz. The three localities, therefore, appear to be well selected; and when the lights are erected, every desirable object will be accomplished.

Alcatraz, or Bird island, is a large rock, rising to an elevation of one hundred and thirty-five feet above high-water mark. Its greatest length and breadth are one thousand six hundred and seventy-three, and five hundred and ninety feet, respectively. The summit is rounded, and has a thin layer of soil, the rock itself being soft, friable, and easily excavated; deep water-marks all around the island, and, with the exception of at two or three particular places, the sides are so precipitous that a landing can be with difficulty effected.

Fort Point is sixteen thousand seven hundred and ninety-eight feet, or three miles three hundred and nineteen yards, from Alcatraz island, and commands a full view of the entrance to the bay. The proposed site for the light-house is on an elevated and prominent point, (one hundred and seven feet above high-water mark,) and which was formerly occupied as a Mexican fort.

The sites for light-houses are marked on the sketches by a circle in red ink.

Fort Point belongs by reservation to the United States. Alcatraz is claimed by purchase from Mexican grants by Col. J. C. Frémont.

Table.

	Height of lantern above base.	Height of base above high-water mark.	Height of lantern above high-water mark.	Distance at which lights would be visible, clear weather, nautical miles.	Statute miles.
Alcatraz island .	20 feet.	135 feet.	155 feet.	17 miles.	21
Fort Point	20 “	107 “	127 “	15 “	19½

I am, &c., yours, truly,

RICH. D. CUTTS,

Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 47.

Report of A. D. Bache, Superintendent of the United States Coast Survey, to the Secretary of the Treasury, correcting important errors in the position of the Farrallones and Point Lobos, entrance to San Francisco Bay.

COAST SURVEY OFFICE,

Washington, April 24, 1851.

SIR: I have the honor to submit the following report from R. D. Cutts, esq., assistant United States coast survey, correcting important errors in previous reports as to the position of the Farrallones and Point Lobos, entrance to San Francisco bay, which I respectfully request authority to publish. These corrections are the results of a trigonometrical survey.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

W. L. HODGE, Esq.,

Acting Secretary of the Treasury.

SCHOONER BALTIMORE,

San Francisco Bay, February 28, 1851.

DEAR SIR: Under the head of the “Farrallones,” in the sailing directions for the western coast, it is stated that—

“The southeast inlet is the largest of the group, and is distant from the fort, at the mouth of the harbor, twenty-eight miles, and bears from fort S. 68° W., time.

In the next edition of these directions the distance may be stated at 29.9 miles, and the true course from fort S. 75° 12' W.

Adopting for the starting point the latitude and longitude of Fort Point, as given by Lieutenant McArthur in the published "tables," the latitude of the South Farrallone becomes $37^{\circ} 41' 37''$, instead of $37^{\circ} 36' 30''$; and the longitude of Point Lobos (the most western extremity) $122^{\circ} 29' 47''$, instead of $122^{\circ} 27' 30''$.

Very truly, yours,

R. D. CUTTS.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 48.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, on the general character of the coast of California.

WASHINGTON, January 6, 1851.

SIR: In answer to your several inquiries of the 31st ultimo, I have the honor to state, that the general character and configuration of the coast of California exhibit bold precipitous cliffs, variable in height, occasionally interrupted by sand and shingle beaches. In some places the shore-line, even where faced by cliffs, is also a flat sand-beach, but in such cases narrow, and entirely washed by a full tide.

On all parts of the coast vessels may approach within a very short distance of the beach, without encountering any dangers not visible to the eye, except that of being hove upon the beach by the swell, if the failing of the wind should leave the vessel becalmed.

The hill-tops are generally rolling, but at times present long ranges of slightly inclined plains, or tables, partially covered with gigantic red-wood timber. Wild oats and rich grasses are abundant on all the hills and forest openings of the coast range.

The islands which lie off the coast between Cape Conception and San Diego are not yet determined in position, with any very close approach to accuracy. They are large and conspicuous objects to the navigation in clear weather, but require more thorough examination and determination. They are as follow: Santa Rosa, or Miguel, San Bernardo, Santa Cruz, Saint Nicholas, Santa Barbara, Santa Catalina, San Clemente, or Salvador, San Juan, and the Coronados isles.

Several of these islands have islets in their vicinity, and there are reefs and detached rocks reported in several places within their range.

Whether these reefs and islets are the *same*, being variously placed by navigators assigning them erroneous positions on the crude charts of that coast, which have been in general use by the coasters, or whether they are more numerous and dangerous than they appear on the general charts of the latest publications, is yet to be ascertained.

There is no part of the coast of the United States that requires an immediate and thorough examination with all the means at the command of the coast survey more than that part included between Monterey and San Diego.

Our late reconnaissance to the northward shows how indeterminate

while the difficulty of transporting supplies from the depot at Eureka seems to be almost an insurmountable objection to its ever becoming a place of much importance. Everything has to be carried in small boats up a very narrow sluice, and that only at high water, while the nearest point of water communication is a mile from the town. A road can be cut from either of the other towns to communicate with the one from Union to the mines, with but little expense or trouble.

I am, sir, very truly and respectfully, yours, &c.,

JAMES ALDEN,

Lieut. Com'g. U. S. N., and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 46.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, transmitting the report of R. D. Cutts, esq., assistant in the coast survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses.

COAST SURVEY OFFICE,

February 13, 1851.

SIR: I have the honor to transmit a report by Assistant R. D. Cutts, of the Coast Survey, with sketches of his survey of Fort Point, at the entrance to San Francisco bay, and of Alcatraz, or Bird island, within the bay, proposed as sites for light-houses in the bill passed at the last session of Congress. The complete drawings which Mr. Cutts forwarded by Adams & Co.'s express have not come to hand, but the report and sketches of the sites, with a tracing from the chart of the bay, which shows the relative positions of the points, will supply the information essential to the action of the department. When the complete drawings are received, I will replace these and sketches by copies of them.*

I have examined, and confirm, the recommendations made by Mr. Cutts in his report; nor have any facts come to my knowledge from inquiries made of Lieutenant Patterson, United States navy, formerly attached to the Coast Survey, who has commanded the mail-steamer Oregon, plying on the western coast, of Lieutenant Bartlett, recently engaged in the hydrography of the western coast, and of Passed Midshipman McLane, second officer of the mail-steamer "Panama," and recently attached to the Coast Survey, to indicate that the location already adopted for lights at the entrance of San Francisco bay (the South Farrallone, Fort Point, and Alcatraz island) should be altered.

I respectfully recommend for the light on Fort Point one of the sec-

* The drawings were subsequently sent in.

ond order, (French system,) or its equivalent; and for the one on Alcatraz island one of the fourth order, or its equivalent.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOS. CORWIN,
Secretary of the Treasury.

SAN FRANCISCO BAY,
December 27, 1850.

DEAR SIR: In conformity with your instructions of October 5, directing that light-house surveys should be my first and immediate duty upon arriving at San Francisco, I have to report that I have made the necessary examinations and surveys of Alcatraz island and Fort Point, in the Bay of San Francisco, the results of which, and sketches on a scale of $\frac{1}{10000}$, are herewith forwarded.

The magnetic course of Alcatraz island from Fort Point is N. 53 E., say NE., by E. which is the best range for crossing the bar and for passing between Points Lobos and Boucta. The Farrallones are visible from Alcatraz. The three localities, therefore, appear to be well selected; and when the lights are erected, every desirable object will be accomplished.

Alcatraz, or Bird island, is a large rock, rising to an elevation of one hundred and thirty-five feet above high-water mark. Its greatest length and breadth are one thousand six hundred and seventy-three, and five hundred and ninety feet, respectively. The summit is rounded, and has a thin layer of soil, the rock itself being soft, friable, and easily excavated; deep water-marks all around the island, and, with the exception of at two or three particular places, the sides are so precipitous that a landing can be with difficulty effected.

Fort Point is sixteen thousand seven hundred and ninety-eight feet, or three miles three hundred and nineteen yards, from Alcatraz island, and commands a full view of the entrance to the bay. The proposed site for the light-house is on an elevated and prominent point, (one hundred and seven feet above high-water mark,) and which was formerly occupied as a Mexican fort.

The sites for light-houses are marked on the sketches by a circle in red ink.

Fort Point belongs by reservation to the United States. Alcatraz is claimed by purchase from Mexican grants by Col. J. C. Frémont.

Table.

	Height of lantern above base.	Height of base above high-water mark.	Height of lantern above high-water mark.	Distance at which lights would be visible, clear weather, nautical miles.	Statute miles.
Alcatraz island .	20 feet.	135 feet.	155 feet.	17 miles.	21
Fort Point	20 “	107 “	127 “	15 “	19½

I am, &c., yours, truly,

RICH. D. CUTTS,

Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 47.

Report of A. D. Bache, Superintendent of the United States Coast Survey, to the Secretary of the Treasury, correcting important errors in the position of the Farrallones and Point Lobos, entrance to San Francisco Bay.

COAST SURVEY OFFICE,

Washington, April 24, 1851.

SIR: I have the honor to submit the following report from R. D. Cutts, esq., assistant United States coast survey, correcting important errors in previous reports as to the position of the Farrallones and Point Lobos, entrance to San Francisco bay, which I respectfully request authority to publish. These corrections are the results of a trigonometrical survey.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

W. L. HODGE, Esq.,

Acting Secretary of the Treasury.

SCHOONER BALTIMORE,

San Francisco Bay, February 28, 1851.

DEAR SIR: Under the head of the “Farrallones,” in the sailing directions for the western coast, it is stated that—

“The southeast inlet is the largest of the group, and is distant from the fort, at the mouth of the harbor, twenty-eight miles, and bears from fort S. 68° W., time.

In the next edition of these directions the distance may be stated at 29.9 miles, and the true course from fort S. 75° 12' W.

Adopting for the starting point the latitude and longitude of Fort Point, as given by Lieutenant McArthur in the published "tables," the latitude of the South Farrallone becomes $37^{\circ} 41' 37''$, instead of $37^{\circ} 36' 30''$; and the longitude of Point Lobos (the most western extremity) $122^{\circ} 29' 47''$, instead of $122^{\circ} 27' 30''$.

Very truly, yours,

R. D. CUTTS.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 48.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, on the general character of the coast of California.

WASHINGTON, January 6, 1851.

SIR: In answer to your several inquiries of the 31st ultimo, I have the honor to state, that the general character and configuration of the coast of California exhibit bold precipitous cliffs, variable in height, occasionally interrupted by sand and shingle beaches. In some places the shore-line, even where faced by cliffs, is also a flat sand-beach, but in such cases narrow, and entirely washed by a full tide.

On all parts of the coast vessels may approach within a very short distance of the beach, without encountering any dangers not visible to the eye, except that of being hove upon the beach by the swell, if the failing of the wind should leave the vessel becalmed.

The hill-tops are generally rolling, but at times present long ranges of slightly inclined plains, or tables, partially covered with gigantic red-wood timber. Wild oats and rich grasses are abundant on all the hills and forest openings of the coast range.

The islands which lie off the coast between Cape Conception and San Diego are not yet determined in position, with any very close approach to accuracy. They are large and conspicuous objects to the navigation in clear weather, but require more thorough examination and determination. They are as follow: Santa Rosa, or Miguel, San Bernardo, Santa Cruz, Saint Nicholas, Santa Barbara, Santa Catalina, San Clemente, or Salvador, San Juan, and the Coronados isles.

Several of these islands have islets in their vicinity, and there are reefs and detached rocks reported in several places within their range.

Whether these reefs and islets are the *same*, being variously placed by navigators assigning them erroneous positions on the crude charts of that coast, which have been in general use by the coasters, or whether they are more numerous and dangerous than they appear on the general charts of the latest publications, is yet to be ascertained.

There is no part of the coast of the United States that requires an immediate and thorough examination with all the means at the command of the coast survey more than that part included between Monterey and San Diego.

Our late reconnoissance to the northward shows how indeterminate

have been previous authorities, and how very much superior it is to previously conceived notions.

To the southward and eastward of Point Conception the islands of San Bernardo, San Miguel, and Santa Cruz form the western border of the Santa Barbara channel or sound. This is the route of the coasting trade and Pacific mail steamships generally.

The light-house proposed to be erected on Cape Conception will be of great benefit to this trade.

In consequence of fogs and haze, the cape (which is bold, and clear of danger) must be made, in order to shape a course with certainty through the channel or sound of Santa Barbara.

The island of San Bernardo lies nearly due south of Cape Conception, distant 30 miles, "San Miguel" 33 miles SE., (compass,) and "Santa Cruz" 33 miles ESE., and eleven miles south of the anchorage of Santa Barbara.

The coast is clear of dangers, both on the main land and the eastern shores of the island. Navigators prefer to take the channel, in consequence of reported reefs and shoals, to the westward of San Miguel and north of San Nicholas. There is no doubt such do exist, and are as yet very uncertain in position.

The light-house for Cape Conception should be as near the shore as possible, having regard to height, for sea view. This light should be seen ten or eleven leagues, and be of the first class.

A position can be had for Conception light which will not require a tower higher than those on Navesink.

Beginning with the light at the Farrallone, off San Francisco, as a fixed light, I would recommend the following order to the southward:

Monterey a revolving light.

Cape Conception a fixed "

San Diego a revolving "

As the above will all be main sea-lights, they should be of the first class.

All other lights which the future wants of commerce may require in this district will only be secondary or local lights.

Respectfully submitted by your obedient servant,

WASHINGTON A. BARTLETT,

Lieutenant U. S. Navy, and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 49.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating a letter from Lieut. W. A. Bartlett, U. S. N., assistant in coast survey, relating to the commerce of the Columbia River.

COAST SURVEY OFFICE,

February 26, 1851.

SIR: I have the honor to send herewith a letter from Lieut. Wash'n A. Bartlett, United States navy, assistant in the coast survey, enclosing a

list of vessels which have crossed the bar of the Columbia river during the year 1850. I respectfully request that it may be communicated to the Committees on Finance and Commerce of the Senate, and Committee on Commerce of the House of Representatives.

Yours, very respectfully,

A. D. BACHE,
Superintendent Coast Survey.

Hon. THOS. CORWIN,
Secretary of the Treasury.

NATIONAL HOTEL, WASHINGTON,
February 24, 1851.

DEAR SIR: I herewith enclose a list of vessels which have crossed the bar of the Columbia river, Oregon Territory, during the year 1850. I received it this evening direct from the United States collector at Astoria.

By this list you will perceive that while the large number of 160 sail—of ships, barques, brigs, and steamers—have safely crossed the bar of the Columbia river during the year, no less than one hundred and forty-four sail have entered and departed by the new south channel, which was surveyed by the late Lieutenant Commanding W. P. McArthur, U. S. N., and myself, under your direction, the past season; the chart of which is now being engraved.

This list of vessels embraces a fleet of over eighty thousand tons burden, which in one year have entered and cleared at the custom-house at Astoria, without a solitary accident or loss of one dollar to owners or insurers by the passage of the bar.

It is very doubtful whether the commercial statistics of any other port of equal commerce can show such an exhibit.

Of the sixteen passages made through the old north channel, all but three were made by steam vessels, which fact has fully demonstrated two things: *first*, that the prediction long since made, that steam would certainly and safely open the navigation of the Columbia, and, *secondly*, that our reports of the past summer, that the *south channel* is the *practical commercial channel* of the river, are fully established to be correct by the showing of the pilots; they having taken *one hundred and forty sail* of sailing vessels through the *south channel*, while only *four* have passed through the *north channel*.

Since the publication of our sailing directions in June last, *ten sailing vessels have passed through the south channel without a pilot!*

The pilots have taken $17\frac{1}{2}$ feet draught over the bar of the south channel.

In view of these facts, and my experience of the wants of the usual aids to commerce on this river, I have been addressed by a large number of the ship-masters and owners of vessels trading into the Columbia, to urge upon the proper departments of the government the necessity of hastening the work of building the light-houses, and placing the buoys, already provided by act of Congress.

Also, that the growing commerce of the port of Astoria demands an

immediate appropriation for a custom-house at that point, in order that the public business may be properly transacted. I have the honor, therefore, to request that copies of this communication be transmitted to the Secretary of the Treasury, and the Committee on Finance of the United States Senate.

In this connexion I may also mention that I was this day informed by Mr. Preston, surveyor general for Oregon, that in consequence of the publication of my report, made to you in June last, of the safety of the south channel of the Columbia, the insurance companies of St. Louis at once took risks for the river, at the same as for San Francisco. This is the direct influence of correct hydrographical information.

Sir, I have the honor to be, with high respect, your obedient servant,

WASH'N A. BARTLETT,

Lieut. Com'g U. S. N., and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent Coast Survey.

APPENDIX No. 50.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating information relating to Trinidad, Humboldt, and San Diego bays.

OSSIPEE STATION, NEAR ALFRED, MAINE,

September 29, 1851.

DEAR SIR: The following information in regard to Humboldt harbor, Trinidad bay, and San Diego harbor and its approaches, has been received from Lieutenant Commanding James Alden, United States navy, Assistant R. D. Cutts, and Sub-Assistant A. M. Harrison. I would respectfully request authority for its publication.

Trinidad and Humboldt bays have been surveyed, and the charts will be ready to forward by the first proximo. The first-named is a very convenient and safe anchorage during six months in the year, and will be found by vessels that have suffered from the strong head (northerly) winds that prevail along the coast, a comfortable harbor of refuge.

Humboldt bay is, I think, the third harbor on this coast; it is sixteen miles long, and from three-quarters to four or five miles wide. The entrance between the breakers is nearly straight, but rather along the coast; it is about a mile long, and two hundred metres wide, between the eighteen-foot curves on either side, with twenty-one feet at low water on the bar. It is perfectly accessible, except in very heavy weather, when, I am informed, the sea breaks entirely across the entrance; but we had no trouble in getting in, and *beat out* against a very light air, with little or no tide in our favor. We have made a very careful examination of it.

San Diego bay.—From the perfect shelter it affords from all winds, and the depth of its water, San Diego bay is considered, next to San Francisco, the best on this coast. That such a large volume of water

should have such a small outlet is somewhat remarkable, as is also the very singular natural breakwater, Ballast point.

The Port La Playa is situated on the western shore of the bay, about one mile and three-quarters from the entrance. The anchorage is in between nine and ten fathoms. The custom-house is placed here, and it is also the place where the mail-steamers stop. An excellent road leads from La Playa to Old San Diego, which is a small town of a few adobe houses and unapproachable by water, even in boats.

New San Diego, now about a year old, is situated on a plain, at the base of the hills, on the east side of the bay. It consists of a few American-built houses, and a large storehouse for the quartermaster's department. The United States military depot is established there. A channel runs in a curve from La Playa to New San Diego, and vessels can carry from six to seven fathoms water. Both New San Diego and La Playa are dependent upon the river at Old San Diego for their water. Between the above-named channel and Old San Diego are large flats, mostly covered with grass, and partly bare at low tide.

The most important subject, however, connected with the bay, is the effect of the debouchement of the San Diego river—bringing with it, when high, (in the rainy season,) great quantities of sand directly into the channel.

It is believed, and apparently with reason, that unless the course of the river be changed, the channel will be ultimately filled, which will have the effect, I think, of not only cutting off communication with New Town, but also of destroying the bay entirely as a harbor; for it appears that nothing keeps the bay open but the great amount of water flowing in and out at the narrow entrance; and, when the channel is closed, the greater part of the bay is cut off, leaving an insufficient amount to keep the entrance clear. A bar would doubtless form across the mouth, and the bay will gradually fill up.

That the river does bring sand into the bay is asserted by the deputy collector of this place, and others who have the means of knowing; and, further, it is known that vessels at one time could anchor in False bay, but the river flowing into it destroyed it by filling it with sand; and it then turned its course into San Diego bay.

If such be the facts—and I see no reason to doubt them—the only remedy for the evil is to turn the river into False bay again. This is an excellent harbor, and its loss would be severely felt.

Respecting the tides, Mr. Gray gives the average as six feet, which is approximately correct. The pilots tell me that the tides vary in their rise and fall from nine feet (spring-tides) to three and a half during the year.

About two-thirds of the way from the Playa to the end of Ballast point is a shoal, having nine feet of water at low tide, but lately discovered.

Sailing directions for San Diego.—Vessels in sight of the coast, and approaching San Diego from the north, will observe an opening in the hills, and the appearance of an inland bay. This is the "False port," and must be avoided. Immediately north of "False port" commences a table land, about four hundred and fifty feet high, and extending southwardly six or seven miles. The extremity of this table-land is called Point Loma, and forms the entrance to the harbor of San Diego.

Those bound from the southward will first sight the group of high, rocky islets, called "*Los Coronados*." From thence to Point Loma the course is N. $\frac{1}{2}$ E., and the distance fifteen nautical miles. On a clear day "*Los Coronados*" will serve as a landmark and guide for vessels coming from any direction.

Steer right through the kelp, giving Point Loma a berth of one-half mile, and in a few minutes you will open Ballast point, a low beach of shingle stones forming a natural breakwater. Then round up gradually, until you bring Ballast point in range with the easternmost house on the Playa, *and be very careful not to open more of the village*; otherwise you will be too far to the east and in danger of getting aground on Zuningo shoal. The breakers show its position. During the summer keep as close to the hills, on your port side, as your draught of water will allow, as you will then be able to lay on the wind right up to Ballast point. You can carry four fathoms within a ship's length of the point. Keep on the above range, and, when up with Ballast point, steer direct for the Playa, and anchor as you please.

Inside of the breakwater, and about two hundred and fifty yards true north of its extremity, is a shoal spot, with twelve feet water at low tide. The shoals on the starboard hand are plain in sight, except at very high water.

Beyond the Playa, the shoals are easily distinguished. The channel, however, is buoyed. From the Playa to New Town—four miles distant—you can carry six fathoms of water. A mile or two beyond New Town the bay becomes shoal.

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent*.

Hon. THOS. CORWIN,
Secretary of the Treasury.

APPENDIX No. 51.

Sailing directions for entering the Columbia river as far as the harbor of Astoria, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

It is best, under all circumstances, to have a pilot; but should it be necessary to enter the river without one, the directions for the north channel are: First, bring Sand island in range with Point Ellice, and stand in towards Sand island, passing the south end of the north breaker. When Cape Disappointment and Leading-in cliff are in range, haul off towards the cape, keeping Leading-in cliff in range until nearly abreast the cape. Give the cape a small berth, and continue on towards Baker's bay until the second island in the bay can be seen; then keep off, and, with the second island and cape in range astern, it will pass clear of the north part of the middle sands. As soon as the soundings shoal on this course, keep off towards Sand island, and, passing close by the east end of the island, get the beacon on the island in range with a tree on Cape Disappointment, (which is trimmed up

like an umbrella,) and, with that range astern, stand on up the bay until the custom-house is on with Young's point, when haul to the east, and keep the last range on till nearly up with Young's point. Pass along the south shore, running by the lead, until up to Astoria.

To enter the south channel, bring the beacon on Sand island to bear north 40° east, (true,) and Point Adams on the peak, which can be seen east of Point Ellice, called "Jim Crow," (upon which there is a notable tree,) nearly in range; the vessel will be then on the bar in the south channel, in the best water. Steer for the beacon, taking care not to sag to the eastward; rather keep close to the breakers on the Sand island shore. Pass close to Sand island, and fall into the range of the beacon with the trimmed tree on Cape Disappointment, and proceed as already directed.

The best time for entering is on the first or last of the ebb-tide. The last of the ebb-tide is preferable in either channel.

APPENDIX No. 52.

Correspondence of Superintendent of the Coast Survey with the Secretary of the Treasury in relation to two sunken rocks in the harbor of San Francisco, reported by collector of that port.

1.

TREASURY DEPARTMENT,
July 21, 1851.

SIR: The enclosed letters from the collector of San Francisco, requesting that buoys be placed over two sunken rocks therein mentioned, are transmitted for your views on the subject.

You will please return the letters with your report, and if any report shall have been made to you by the officers of the coast survey in California, I will thank you to furnish a copy to the department.

Very respectfully, your obedient servant,

W. L. HODGE,
Acting Secretary of the Treasury.

Prof. A. D. BACHE,
Superintendent Coast Survey.

2.

COLLECTOR'S OFFICE, CUSTOM-HOUSE,
San Francisco, June 7, 1851.

SIR: I have the honor to enclose a copy of a letter I have addressed to the Hon. Stephen Pleasonton, Fifth Auditor, requesting authority to procure two buoys to place on two sunken rocks, very dangerous to vessels navigating the waters of this bay. It is of great importance

that these dangerous rocks should be indicated to navigators; and I trust the requisite steps may be taken as promptly as possible.

I have the honor to be, with great respect, your most obedient servant,

T. BUTLER KING, *Collector.*

Hon. THOMAS CORWIN,

Secretary of the Treasury, Washington City.

—

3.

COLLECTOR'S OFFICE, CUSTOM-HOUSE,
San Francisco, June 7, 1850.

SIR: There are two sunken rocks in the straits between the bays of San Francisco and San Pablo, which are very dangerous to navigation, being directly in the track of vessels navigating these waters. Application has been made to me to have buoys placed upon them, and the officers engaged in the coast survey are ready to place buoys whenever they can be procured. Under these circumstances, please authorize some person to procure buoys to mark these dangerous hindrances to navigation.

Very respectfully, your obedient servant,

T. BUTLER KING, *Collector.*

Hon. STEPHEN PLEASANTON,

Fifth Auditor, Treasury Department, Washington City.

—

4.

C. S. STATION, MT. PLEASANT, ME.,
July 25, 1851.

SIR: I have the honor to acknowledge the receipt of your favor of the 21st instant, relating to buoys to be placed upon two sunken rocks in the bay of San Francisco, and requesting to be furnished with the information communicated to the superintendent by the officers of the survey.

In reply, I have the honor to state that Lieutenant Commanding Jas. Alden, U. S. N., assistant in the coast survey, and chief of hydrographic party on the western coast, under date of June 14, informs me that he has received numerous applications to place buoys on the Invincible and Blossom rocks, in the harbor of San Francisco, and that he considers it very necessary to the safety of navigation that buoys should be placed upon those dangers.

Fully concurring with Lieutenant Alden in his opinion, I would respectfully recommend that the necessary means may be furnished to the collector of the port of San Francisco, or to the superintendent of the coast survey, from any funds the department may have available for the purpose, to have the buoys procured and placed.

I return herewith the letters of Mr. King, the collector, as you request.

Yours, respectfully,

A. D. BACHE, *Superintendent.*

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

APPENDIX No. 53.

Report of Lieutenant Commanding James Alden, U. S. navy, assistant in the coast survey, to the Superintendent, of the death of Passed Midshipman William De Koven, U. S. navy, assistant in the coast survey, on the thirty-first of May, 1851.

U. S. SURVEYING SCHOONER EWING,

San Francisco, May 31, 1851.

DEAR SIR: I have just time, before the steamer sails, to impart to you the melancholy news of the sudden death of Passed Midshipman William De Koven. His disease was apoplexy; and when I mailed my last letter to you, one short hour ago, he was not thought to be in any danger. I had known him but a few days, but in that time learned to honor and respect the noble qualities which adorned his character. This sudden and awful event has cast the deepest gloom over us all, and our thoughts turn with the saddest sympathy to those bereaved relatives and friends, whose hopes and affections are thus, in one short hour, made so desolate.

I enclose herewith Dr. Mitchell's report of the circumstances attending Mr. De Koven's death, and beg that, as there is not time before the steamer sails to do so myself, you will please to impart the sad intelligence to his friends, and to the Hon. Secretary of the Navy.

With great respect, I am sir, your obedient servant,

JAMES ALDEN,

Lieutenant Commanding, U. S. Navy.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, &c., Washington, D. C.

APPENDIX No. 54.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the loss of the steamer Jefferson on the coast of Patagonia; with documents relative thereto.

1.

OSSIPEE STATION, NEAR ALFRFD, ME.,

September 1, 1851.

SIR: It is my unpleasant duty to report officially—what has already been communicated to you informally by the assistant in charge of the

coast survey office—the wreck of the steamer Jefferson, and her abandonment after survey, at Port Desire, Eastern Patagonia.

The whole of the circumstances are described in the letter of Lieutenant Commanding F. K. Murray, United States navy, a copy of which is herewith transmitted, together with a copy of the report of the officers who made the examination of the vessel at Port Desire; and recommended her abandonment as beyond the means accessible for repairs.

Such was the violence of the storm to which the vessel was exposed, that there appears more cause for thankfulness that the lives of the officers and crew were preserved than of regret that the vessel was disabled. The commander, and his officers and crew, appear to have done all that was practicable under the circumstances.

I transmit herewith a copy of the letter of Lieutenants Alden and Jenkins, recommending the sending of the Jefferson to the western coast; and of that of Lieutenant Commanding Murray, in reply to inquiries addressed by me to him before leaving port. The department will see from them that the best professional advice was had before sending the vessel to the western coast, and that she was fully equipped for the voyage.

I have not yet received advices of the arrival of the officers and men of the Jefferson in the United States. It will be seen that their return may soon be expected, and that such portions of the machinery of the steamer as it may be possible to ship will be brought with them.

Very respectfully, yours,

A. D. BACHE, *Superintendent, &c.*

Hon. THOS. CORWIN,

Secretary of the Treasury.

—
2.

Letter of Lieutenant Commanding F. K. Murray, United States navy, to Superintendent of Coast Survey, reporting the loss of the Coast Surveying Steamer Jefferson.

U. S. S. STEAMER JEFFERSON,
Port Desire, East Patagonia, June 3, 1851.

SIR: It becomes my unpleasant duty to inform you of the disasters which have befallen the Jefferson since leaving Montevideo, and driven us into this port, a complete wreck. After our sailing, the weather continued good until the 23d ultimo, when its threatening appearance, and the low state of the barometer, gave warning of a heavy gale. It overtook us upon the 24th, from the northward, and as it increased, all necessary and usual precautions were taken to make the vessel secure; the top-gallant yards and mizzen-topmast were sent upon deck; the hatches battened down; relieving tackles hooked, &c.; and until the morning of the 25th, the steamer scudded safely before the wind, which hauled on that day to WNW., and blew with terrific violence, raising a mountainous, irregular, and cross sea, which con-

stantly threatened our destruction. To keep ahead of this, all sail that could be carried in addition to full steam was necessary; and at 3 o'clock, p. m., she had on the close-reefed foresail; close-reefed maintop-sail, and reefed fore storm-staysail. At about that time, a heavy cross sea from the northward broke over the port-gangway, and threw the vessel upon her beam-ends, when she instantly broached to and lay exposed to the heavy sea following us. I was on deck, as I had been, without interruption, during the gale, and immediately gave the order to let everything fly but the staysail sheet; and quickly afterwards, finding she did not recover, that the sea continued to break over her, and the vessel to settle, to cut away her masts. To the promptness and coolness with which this order was obeyed, we are indebted for our lives. Relieved of the masts, she righted and fell off before the wind; but, for some moments before their fall, there appeared no earthly hope that the vessel could remain above water a minute, so fast and far had she settled into the sea. Fortunately, both masts fell clear of the wheel-houses, but for some time we lay exposed to the fury of the waves, until their rigging could be disentangled from the lee-wheel. This accomplished, I directed the vessel to be hove to under low steam and the reefed spanker, the only sail left; for, fortunately, the mizzen-mast was retained when the fore and main fell.

At about six o'clock, while laying to, another heavy sea broke on board, on the port-bow, and swept fore and aft, staving in the bulkheads of the engine-room, wheel-houses, &c., and carrying the steering-wheel overboard. This shock strained the steamer's hull terribly from bow to stern, and she afterwards worked and labored so much that I was apprehensive she would break in two. As soon as the hatches could be opened, I ordered water, provisions, stores, everything that could possibly be spared, to be thrown overboard, which was done with excellent effect; but, though relieved, the working of the vessel's frame continued to such a degree that it appeared doubtful whether she could hold together to reach port. To add to our misfortunes, the vessel had begun to leak badly; the bilge-pumps, choked by the coal, would not work, (no uncommon occurrence with them;) and the frames of the engines had started from the hull, and, though instantly secured by chain, were momentarily expected to break down, and under full steam could make but six revolutions. It appeared that nothing but a miraculous interposition of Providence could save us, and we have great cause for gratitude that this was accorded us; for in a few minutes after the shock which disabled the vessel, the wind hauled to the southward and westward, and began to die away, and the sea to subside. A continuance of the gale, or another of even ordinary strength, before we reached here, would have caused our destruction. We continued to lay to until noon of the 26th, when we found ourselves, by observation, distant 110 miles from Sea Bear bay, bearing SW. by S. The sea having gone down, and a jury-mainmast been rigged, I steered for that port, but, owing to the state of the engines and hull, our progress was slow, and we did not arrive until the 28th, in the afternoon. Yesterday I brought the vessel to this port, (which is in sight from Sea Bear bay,) finding it to be better protected from the gales which prevail at this season.

that these dangerous rocks should be indicated to navigators; and I trust the requisite steps may be taken as promptly as possible.

I have the honor to be, with great respect, your most obedient servant,

T. BUTLER KING, *Collector.*

Hon. THOMAS CORWIN,

Secretary of the Treasury, Washington City.

—

3.

COLLECTOR'S OFFICE, CUSTOM-HOUSE,
San Francisco, June 7, 1850.

SIR: There are two sunken rocks in the straits between the bays of San Francisco and San Pablo, which are very dangerous to navigation, being directly in the track of vessels navigating these waters. Application has been made to me to have buoys placed upon them, and the officers engaged in the coast survey are ready to place buoys whenever they can be procured. Under these circumstances, please authorize some person to procure buoys to mark these dangerous hindrances to navigation.

Very respectfully, your obedient servant,

T. BUTLER KING, *Collector.*

Hon. STEPHEN PLEASANTON,

Fifth Auditor, Treasury Department, Washington City.

—

4.

C. S. STATION, MT. PLEASANT, ME.,
July 25, 1851.

SIR: I have the honor to acknowledge the receipt of your favor of the 21st instant, relating to buoys to be placed upon two sunken rocks in the bay of San Francisco, and requesting to be furnished with the information communicated to the superintendent by the officers of the survey.

In reply, I have the honor to state that Lieutenant Commanding Jas. Alden, U. S. N., assistant in the coast survey, and chief of hydrographic party on the western coast, under date of June 14, informs me that he has received numerous applications to place buoys on the Invincible and Blossom rocks, in the harbor of San Francisco, and that he considers it very necessary to the safety of navigation that buoys should be placed upon those dangers.

Fully concurring with Lieutenant Alden in his opinion, I would respectfully recommend that the necessary means may be furnished to the collector of the port of San Francisco, or to the superintendent of the coast survey, from any funds the department may have available for the purpose, to have the buoys procured and placed.

I return herewith the letters of Mr. King, the collector, as you request.

Yours, respectfully,

A. D. BACHE, *Superintendent.*

Hon. W. L. HODGE,

Acting Secretary of the Treasury.

APPENDIX No. 53.

Report of Lieutenant Commanding James Alden, U. S. navy, assistant in the coast survey, to the Superintendent, of the death of Passed Midshipman William De Koven, U. S. navy, assistant in the coast survey, on the thirty-first of May, 1851.

U. S. SURVEYING SCHOONER EWING,
San Francisco, May 31, 1851.

DEAR SIR: I have just time, before the steamer sails, to impart to you the melancholy news of the sudden death of Passed Midshipman William De Koven. His disease was apoplexy; and when I mailed my last letter to you, one short hour ago, he was not thought to be in any danger. I had known him but a few days, but in that time learned to honor and respect the noble qualities which adorned his character. This sudden and awful event has cast the deepest gloom over us all, and our thoughts turn with the saddest sympathy to those bereaved relatives and friends, whose hopes and affections are thus, in one short hour, made so desolate.

I enclose herewith Dr. Mitchell's report of the circumstances attending Mr. De Koven's death, and beg that, as there is not time before the steamer sails to do so myself, you will please to impart the sad intelligence to his friends, and to the Hon. Secretary of the Navy.

With great respect, I am sir, your obedient servant,

JAMES ALDEN,
Lieutenant Commanding, U. S. Navy.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, &c., Washington, D. C.

APPENDIX No. 54.

Letter of the Superintendent of the Coast Survey to the Secretary of the Treasury, communicating the loss of the steamer Jefferson on the coast of Patagonia; with documents relative thereto.

1.

OSSIPEE STATION, NEAR ALFRFD, ME.,
September 1, 1851.

SIR: It is my unpleasant duty to report officially—what has already been communicated to you informally by the assistant in charge of the

coast survey office—the wreck of the steamer Jefferson, and her abandonment after survey, at Port Desire, Eastern Patagonia.

The whole of the circumstances are described in the letter of Lieutenant Commanding F. K. Murray, United States navy, a copy of which is herewith transmitted, together with a copy of the report of the officers who made the examination of the vessel at Port Desire; and recommended her abandonment as beyond the means accessible for repairs.

Such was the violence of the storm to which the vessel was exposed, that there appears more cause for thankfulness that the lives of the officers and crew were preserved than of regret that the vessel was disabled. The commander, and his officers and crew, appear to have done all that was practicable under the circumstances.

I transmit herewith a copy of the letter of Lieutenants Alden and Jenkins, recommending the sending of the Jefferson to the western coast; and of that of Lieutenant Commanding Murray, in reply to inquiries addressed by me to him before leaving port. The department will see from them that the best professional advice was had before sending the vessel to the western coast, and that she was fully equipped for the voyage.

I have not yet received advices of the arrival of the officers and men of the Jefferson in the United States. It will be seen that their return may soon be expected, and that such portions of the machinery of the steamer as it may be possible to ship will be brought with them.

Very respectfully, yours,

A. D. BACHE, *Superintendent, &c.*

Hon. THOS. CORWIN,

Secretary of the Treasury.

—
2.

Letter of Lieutenant Commanding F. K. Murray, United States navy, to Superintendent of Coast Survey, reporting the loss of the Coast Surveying Steamer Jefferson.

U. S. S. STEAMER JEFFERSON,
Port Desire, East Patagonia, June 3, 1851.

SIR: It becomes my unpleasant duty to inform you of the disasters which have befallen the Jefferson since leaving Montevideo, and driven us into this port, a complete wreck. After our sailing, the weather continued good until the 23d ultimo, when its threatening appearance, and the low state of the barometer, gave warning of a heavy gale. It overtook us upon the 24th, from the northward, and as it increased, all necessary and usual precautions were taken to make the vessel secure; the top-gallant yards and mizzen-topmast were sent upon deck; the hatches battened down; relieving tackles hooked, &c.; and until the morning of the 25th, the steamer scudded safely before the wind, which hauled on that day to WNW., and blew with terrific violence, raising a mountainous, irregular, and cross sea, which con-

stantly threatened our destruction. To keep ahead of this, all sail that could be carried in addition to full steam was necessary; and at 3 o'clock, p. m., she had on the close-reefed foresail; close-reefed maintop-sail, and reefed fore storm-staysail. At about that time, a heavy cross sea from the northward broke over the port-gangway, and threw the vessel upon her beam-ends, when she instantly broached to and lay exposed to the heavy sea following us. I was on deck, as I had been, without interruption, during the gale, and immediately gave the order to let everything fly but the staysail sheet; and quickly afterwards, finding she did not recover, that the sea continued to break over her, and the vessel to settle, to cut away her masts. To the promptness and coolness with which this order was obeyed, we are indebted for our lives. Relieved of the masts, she righted and fell off before the wind; but, for some moments before their fall, there appeared no earthly hope that the vessel could remain above water a minute, so fast and far had she settled into the sea. Fortunately, both masts fell clear of the wheel-houses, but for some time we lay exposed to the fury of the waves, until their rigging could be disentangled from the lee-wheel. This accomplished, I directed the vessel to be hove to under low steam and the reefed spanker, the only sail left; for, fortunately, the mizzen-mast was retained when the fore and main fell.

At about six o'clock, while laying to, another heavy sea broke on board, on the port-bow, and swept fore and aft, staving in the bulk-heads of the engine-room, wheel-houses, &c., and carrying the steering-wheel overboard. This shock strained the steamer's hull terribly from bow to stern, and she afterwards worked and labored so much that I was apprehensive she would break in two. As soon as the hatches could be opened, I ordered water, provisions, stores, everything that could possibly be spared, to be thrown overboard, which was done with excellent effect; but, though relieved, the working of the vessel's frame continued to such a degree that it appeared doubtful whether she could hold together to reach port. To add to our misfortunes, the vessel had begun to leak badly; the bilge-pumps, choked by the coal, would not work, (no uncommon occurrence with them;) and the frames of the engines had started from the hull, and, though instantly secured by chain, were momentarily expected to break down, and under full steam could make but six revolutions. It appeared that nothing but a miraculous interposition of Providence could save us, and we have great cause for gratitude that this was accorded us; for in a few minutes after the shock which disabled the vessel, the wind hauled to the southward and westward, and began to die away, and the sea to subside. A continuance of the gale, or another of even ordinary strength, before we reached here, would have caused our destruction. We continued to lay to until noon of the 26th, when we found ourselves, by observation, distant 110 miles from Sea Bear bay, bearing SW. by S. The sea having gone down, and a jury-mainmast been rigged, I steered for that port, but, owing to the state of the engines and hull, our progress was slow, and we did not arrive until the 28th, in the afternoon. Yesterday I brought the vessel to this port, (which is in sight from Sea Bear bay,) finding it to be better protected from the gales which prevail at this season.

I omitted to mention that, at the time of her accident, the *Jefferson* had but seventy tons of coal on board, the deck-load taken on board at Montevideo having been consumed.

After my arrival in port, the disabled state of the vessel became with me a matter of painful consideration. I had hoped that she might be repaired so as to continue her voyage; but on a close examination the painful conviction forced itself upon me that to attempt it would be to incur an unavailing and fruitless expense. The vessel is evidently shattered fore and aft, continues to leak badly at her anchors, droops forward and aft, and presents every appearance of having broken amidships.

In my opinion, and in that of the officers, as contained in their report, an iron vessel cannot be extensively repaired out of dock; certainly not by heaving down, in any port of this rock-bound coast—exposed to boisterous weather, heavy seas, and a rise and fall of tide of over twenty feet. I have directed a survey upon the hull of the steamer by the engineer and other officers attached to her, and herewith enclose their report, in which I feel it a duty to those whose lives are intrusted to my charge to coincide. As they considered that the necessary repairs cannot be made out of dock, and the vessel utterly unseaworthy in her present state, as whether we return or go forward, proceed north or south, there lies before us a dangerous and tempestuous coast, I see no alternative but to adopt the unanimous advice of the officers under my command, and abandon the wreck. I have therefore directed the machinery, boilers, &c., to be removed, and, with whatever other government property can be shipped to advantage, intend to place them on board a vessel now loading here for the United States, and expected to sail in a month or six weeks, should no earlier opportunity offer. I shall also return in her with the officers and men.

Within twelve miles of this port, on Penguin island, is a settlement of guano gatherers. The gentlemanly proprietor of the island, Mr. Powell, has kindly offered us every assistance in his power, and will provide provisions for the crew during our stay.

In conclusion, sir, I need hardly say that I abandon this vessel with feelings of deep regret, but with a consciousness that my duty requires it; and that during the perils through which we have passed, no effort was wanting on the part of myself and officers to secure her safety and that of her crew. I take pleasure in bringing to your notice the excellent conduct of all under my command during the trying scenes of the late gale. To their firmness, coolness, and prompt obedience of orders, at a time when death appeared inevitable, we owe our lives, and the government what has been saved from the wreck. For seventy-two hours all hands were constantly on deck at the pumps and bailing, without rest, drenched by the sea, and benumbed by cold; yet all did their duty with a courage and manliness to which I am proud to bear testimony. I would particularly mention the conduct of Mr. Garvin, the engineer in charge. His gallantry in perilling his life in the wheel, held only by the engine, and on which the sea was constantly breaking, to clear it of the rigging of the wreck of the foremast. I am happy to say that no lives were lost, though several men were severely injured during the gale; but I regret to inform you of the death of Lewis M.

Dumore, (landsman,) of Wilmington, Delaware, which occurred suddenly on the 21st ultimo.

I am, very respectfully, yours, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Prof. A. D. BACHE,
Superintendent Coast Survey, Washington D. C.

—

3.

Letter of Lieutenant Commanding Murray, U. S. N., to the officers of the Jefferson, ordering a report of the injuries sustained and the course to be pursued in relation to her; and their reply.

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

GENTLEMEN: You will hold a survey upon this vessel, and report to me what injuries have been sustained in her hull and engines during the recent gale of the twenty-fifth ultimo; whether she is now in a situation to go to sea, or can be repaired so as to enable her to do so. If in your opinion she is unseaworthy, and cannot be repaired here, you will please state what course it would be most advantageous to pursue with regard to her.

I am, respectfully, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Acting Master C. W. PLACE,
Passed Midshipman W. H. WILCOX,
Passed Midshipman G. CILLEY,
Passed Midshipman D. P. McCORKLE,
First Assistant Engineer B. F. GARVIN,
Second Assistant Engineer R. H. LONG,
Second Assistant Engineer W. NONES,
Third Assistant Engineer W. H. RUTHERFORD.

—

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

SIR: In compliance with your order of June 3, we have held a survey upon this vessel, and report the injuries sustained in her hull and engines during the recent gale of the twenty-fifth ultimo, as follows, viz: She droops on starboard bow and port-quarter, has the appearance of being logged, which opinion is strengthened by her working and laboring very much in a sea-way. She makes twenty-three or twenty-four inches of water per day, from which we conclude that some rivets on the bottom have started. Fore and mainmast gone, and jib-boom gone, with their sails and rigging. Decks droop and leak fore and aft; all the joiner's work on the forward and after-guards gone. Wheel-houses

and port hammock-netting partially carried away; also steering-wheel and engine-room bulk-head stove in; a bad leak on the starboard bow; first cutter's planking stove off; upper half-ports and binnacle gone; the ship steering wildly, rudder is supposed to be injured; deck pump flanch broken; outer frames of the engines work three inches, and engines work fore and aft.

We do not consider her in a situation to go to sea; neither can she be repaired so as to enable her to do so without being docked; and in our opinion she is unseaworthy, and cannot be repaired here; and, in duty bound, we unhesitatingly advise that all valuable property on board should be taken from her, and, with the ship's company, embarked on board some staunch vessel to return to the United States, abandoning her much-wrecked hull and leaving an agent in charge for further instructions.

We are respectfully, &c.,

C. W. PLACE,

Acting Master.

WM. H. WILCOX,

Passed Midshipman.

GREENLEAF CILLEY,

Passed Midshipman.

D. P. McCORKLE,

Passed Midshipman.

BENJ. F. GARVIN,

First Assistant Engineer.

ROBERT H. LONG,

Second Assistant Engineer.

W. H. NONES,

Second Assistant Engineer.

WM. H. RUTHERFORD,

Third Assistant Engineer.

Lieutenant Commanding F. K. MURRAY,

Commanding United States Steamer Jefferson.

—
4

Report of Lieutenants Commanding James Alden and Thornton A. Jenkins, in regard to fitness of steamer Jefferson for hydrographic party on western coast.

UNITED STATES COAST SURVEY STEAMER JEFFERSON,

Baltimore, October 17, 1850.

SIR: We have respectfully to report, in compliance with your instructions of the 15th instant, on the points contained therein, viz:

1. That the steamer Walker is not adapted to hydrographic service on the western coast as an efficient steam vessel.

2. That the Jefferson may be rendered fit for that service, and may be sent safely under sails to her destination.

3. To prepare the Jefferson to proceed with expedition to the Pacific,

it will be necessary to have the wheel-houses and wheels taken down, and the parts so fitted as to enable the engineer's crew on board to replace them in the space of three to four weeks' time.

4. It will be necessary to convert the Jefferson into a barque; her fore and mainmasts occupying the same position as at present, and a small mizzen-mast, placed just forward of the cabin bulk-head, to carry a spanker. The fore and mainmasts and spars to be of the proper dimensions of a sailing vessel of her tonnage.

5. To make the Jefferson an efficient steamer surveying vessel, there will be required new boilers, new bilge and force-pumps, and the necessary connexions to be made to the new boilers.

6. It will require from six to seven weeks to construct the boilers, and from three to four weeks to put them in their places and fit the proper connexions.

7. The Jefferson can be masted and rigged in a month from the time the order may be given, if attended to by a competent and zealous officer.

8. It is believed the engines can be thoroughly overhauled and put in complete order for any service connected with hydrography, embracing the recommendations of the engineers appended, for the sum of

Probable cost of boilers..... \$1,500 00

Amount..... 8,000 00

9. The whole amount for preparing the Jefferson for the voyage around Cape Horn may be assumed at about... 9,500 00

Making the total expense..... 4,000 00

10. We would call your attention to the estimates, &c., appended, upon which we have been compelled to rely in a great measure.

11. The crew can dismantle the vessel after reaching her destination in about three days.

12. To get her ready for steaming it will require about four week's work by her engineers and firemen.

13. The carpenters of the vessel could replace the wheel-houses in a few days, the materials being prepared here for doing so.

Very respectfully submitted.

THORNTON A. JENKINS,

Lieutenant Commanding and Assistant Coast Survey.

JAMES ALDEN,

Lieutenant Commanding and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

I omitted to mention that, at the time of her accident, the Jefferson had but seventy tons of coal on board, the deck-load taken on board at Montevideo having been consumed.

After my arrival in port, the disabled state of the vessel became with me a matter of painful consideration. I had hoped that she might be repaired so as to continue her voyage; but on a close examination the painful conviction forced itself upon me that to attempt it would be to incur an unavailing and fruitless expense. The vessel is evidently shattered fore and aft, continues to leak badly at her anchors, droops forward and aft, and presents every appearance of having broken amidships.

In my opinion, and in that of the officers, as contained in their report, an iron vessel cannot be extensively repaired out of dock; certainly not by heaving down, in any port of this rock-bound coast—exposed to boisterous weather, heavy seas, and a rise and fall of tide of over twenty feet. I have directed a survey upon the hull of the steamer by the engineer and other officers attached to her, and herewith enclose their report, in which I feel it a duty to those whose lives are intrusted to my charge to coincide. As they considered that the necessary repairs cannot be made out of dock, and the vessel utterly unseaworthy in her present state, as whether we return or go forward, proceed north or south, there lies before us a dangerous and tempestuous coast, I see no alternative but to adopt the unanimous advice of the officers under my command, and abandon the wreck. I have therefore directed the machinery, boilers, &c., to be removed, and, with whatever other government property can be shipped to advantage, intend to place them on board a vessel now loading here for the United States, and expected to sail in a month or six weeks, should no earlier opportunity offer. I shall also return in her with the officers and men.

Within twelve miles of this port, on Penguin island, is a settlement of guano gatherers. The gentlemanly proprietor of the island, Mr. Powell, has kindly offered us every assistance in his power, and will provide provisions for the crew during our stay.

In conclusion, sir, I need hardly say that I abandon this vessel with feelings of deep regret, but with a consciousness that my duty requires it; and that during the perils through which we have passed, no effort was wanting on the part of myself and officers to secure her safety and that of her crew. I take pleasure in bringing to your notice the excellent conduct of all under my command during the trying scenes of the late gale. To their firmness, coolness, and prompt obedience of orders, at a time when death appeared inevitable, we owe our lives, and the government what has been saved from the wreck. For seventy-two hours all hands were constantly on deck at the pumps and bailing, without rest, drenched by the sea, and benumbed by cold; yet all did their duty with a courage and manliness to which I am proud to bear testimony. I would particularly mention the conduct of Mr. Garvin, the engineer in charge. His gallantry in perilling his life in the wheel, held only by the engine, and on which the sea was constantly breaking, to clear it of the rigging of the wreck of the foremast. I am happy to say that no lives were lost, though several men were severely injured during the gale; but I regret to inform you of the death of Lewis M.

Dumore, (landsman,) of Wilmington, Delaware, which occurred suddenly on the 21st ultimo.

I am, very respectfully, yours, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Prof. A. D. BACHE,
Superintendent Coast Survey, Washington D. C.

—

3.

Letter of Lieutenant Commanding Murray, U. S. N., to the officers of the Jefferson, ordering a report of the injuries sustained and the course to be pursued in relation to her; and their reply.

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

GENTLEMEN: You will hold a survey upon this vessel, and report to me what injuries have been sustained in her hull and engines during the recent gale of the twenty-fifth ultimo; whether she is now in a situation to go to sea, or can be repaired so as to enable her to do so. If in your opinion she is unseaworthy, and cannot be repaired here, you will please state what course it would be most advantageous to pursue with regard to her.

I am, respectfully, &c.,

F. K. MURRAY,
Lieutenant Commanding.

Acting Master C. W. PLACE,
Passed Midshipman W. H. WILCOX,
Passed Midshipman G. CILLEY,
Passed Midshipman D. P. McCORKLE,
First Assistant Engineer B. F. GARVIN,
Second Assistant Engineer R. H. LONG,
Second Assistant Engineer W. NONES,
Third Assistant Engineer W. H. RUTHERFORD.

—

U. S. STEAMER JEFFERSON,
Port Desire, June 3, 1851.

SIR: In compliance with your order of June 3, we have held a survey upon this vessel, and report the injuries sustained in her hull and engines during the recent gale of the twenty-fifth ultimo, as follows, viz: She droops on starboard bow and port-quarter, has the appearance of being logged, which opinion is strengthened by her working and laboring very much in a sea-way. She makes twenty-three or twenty-four inches of water per day, from which we conclude that some rivets on the bottom have started. Fore and mainmast gone, and jib-boom gone, with their sails and rigging. Decks droop and leak fore and aft; all the joiner's work on the forward and after-guards gone. Wheel-houses

and port hammock-netting partially carried away; also steering-wheel and engine-room bulk-head stove in; a bad leak on the starboard bow; first cutter's planking stove off; upper half-ports and binnacle gone; the ship steering wildly, rudder is supposed to be injured; deck pump flanch broken; outer frames of the engines work three inches, and engines work fore and aft.

We do not consider her in a situation to go to sea; neither can she be repaired so as to enable her to do so without being docked; and in our opinion she is unseaworthy, and cannot be repaired here; and, in duty bound, we unhesitatingly advise that all valuable property on board should be taken from her, and, with the ship's company, embarked on board some staunch vessel to return to the United States, abandoning her much-wrecked hull and leaving an agent in charge for further instructions.

We are respectfully, &c.,

C. W. PLACE,

Acting Master.

WM. H. WILCOX,

Passed Midshipman.

GREENLEAF CILLEY,

Passed Midshipman.

D. P. McCORKLE,

Passed Midshipman.

BENJ. F. GARVIN,

First Assistant Engineer.

ROBERT H. LONG,

Second Assistant Engineer.

W. H. NONES,

Second Assistant Engineer.

WM. H. RUTHERFORD,

Third Assistant Engineer.

Lieutenant Commanding F. K. MURRAY,

Commanding United States Steamer Jefferson.

—
4

Report of Lieutenants Commanding James Alden and Thornton A. Jenkins, in regard to fitness of steamer Jefferson for hydrographic party on western coast.

UNITED STATES COAST SURVEY STEAMER JEFFERSON,

Baltimore, October 17, 1850.

SIR: We have respectfully to report, in compliance with your instructions of the 15th instant, on the points contained therein, viz:

1. That the steamer Walker is not adapted to hydrographic service on the western coast as an efficient steam vessel.
2. That the Jefferson may be rendered fit for that service, and may be sent safely under sails to her destination.
3. To prepare the Jefferson to proceed with expedition to the Pacific,

it will be necessary to have the wheel-houses and wheels taken down, and the parts so fitted as to enable the engineer's crew on board to replace them in the space of three to four weeks' time.

4. It will be necessary to convert the Jefferson into a barque; her fore and mainmasts occupying the same position as at present, and a small mizzen-mast, placed just forward of the cabin bulk-head, to carry a spanker. The fore and mainmasts and spars to be of the proper dimensions of a sailing vessel of her tonnage.

5. To make the Jefferson an efficient steamer surveying vessel, there will be required new boilers, new bilge and force-pumps, and the necessary connexions to be made to the new boilers.

6. It will require from six to seven weeks to construct the boilers, and from three to four weeks to put them in their places and fit the proper connexions.

7. The Jefferson can be masted and rigged in a month from the time the order may be given, if attended to by a competent and zealous officer.

8. It is believed the engines can be thoroughly overhauled and put in complete order for any service connected with hydrography, embracing the recommendations of the engineers appended, for the sum of

Probable cost of boilers..... \$1,500 00

Amount..... 8,000 00

9. The whole amount for preparing the Jefferson for the voyage around Cape Horn may be assumed at about... 9,500 00

Making the total expense..... 4,000 00

10. We would call your attention to the estimates, &c., appended, upon which we have been compelled to rely in a great measure.

11. The crew can dismantle the vessel after reaching her destination in about three days.

12. To get her ready for steaming it will require about four week's work by her engineers and firemen.

13. The carpenters of the vessel could replace the wheel-houses in a few days, the materials being prepared here for doing so.

Very respectfully submitted.

THORNTON A. JENKINS,

Lieutenant Commanding and Assistant Coast Survey.

JAMES ALDEN,

Lieutenant Commanding and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

Reports of Lieutenant Commanding Murray, United States navy, to the Superintendent of the Coast Survey, in relation to the fitness of the Jefferson for voyage to, and duty on, western coast.

WASHINGTON, D. C., February 20, 1851.

SIR: In reply to your inquiries in relation to the surveying steamer Jefferson, * * * * *

* * I respectfully state that, the trial of her boilers and machinery having been made at anchor, I can answer generally that they worked during the greater part of a day to the entire satisfaction of myself and engineers, and that the latter officers were of opinion that no further trial would be necessary before proceeding to sea.

In casks and tanks, the Jefferson carries about 3,500 gallons of fresh water, sufficient, at the ordinary rate of consumption, for about thirty days. The condenser recently fitted to one of the wheel-houses will yield a supply equal to the daily consumption, and will enable us to keep the casks and tanks filled, adding thereby to the vessel's stability under sail.

Eighty tons of coal can be stored in the bunkers; when these are filled, I hope to be able to take twenty more on deck in bags. I cannot say, until all the stores are on board, whether or not it will be prudent to do so.

Her outfit in every particular is good; so also are her spars, sails, and rigging. Three months' provisions for her crew have been put on board, which will last four months, adding thereto the undrawn rations.

Never having been at sea in the Jefferson, I cannot answer positively in regard to the fifth query, but may say that I see no reason to doubt that she will be perfectly safe at sea, and believe that her machinery has never been in so good condition for service as now. Most of her firemen are good mechanics, and will be able, with the means at their disposal, to make any repairs (in case of mishap) which can be effected at sea.

* * * * *

I am, sir, very respectfully, your obedient servant,

F. K. MURRAY,

Lieutenant Commanding Steamer Jefferson.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

—

PHILADELPHIA, February 28, 1851.

SIR: At the request of Mr. Alden, who wished to witness the performance of the Jefferson under way, I made a trip in her to Newcastle on the 25th instant. He has, I presume, informed you of its result, which was perfectly satisfactory, except in one particular—the large consumption of fuel; it having been consumed at the rate of ten tons per day. I enclose a report of the engineer in charge, recommending an

alteration which will tend to economise it; and as time was not allowed to communicate with you, I have authorized the work, which will be completed to-morrow.

With twenty-six pounds of steam, making twenty-one and a half revolutions per minute, the Jefferson came up from Newcastle at the rate of ten knots per hour, against wind and tide, and showed more stability under sail than I had expected. The wind being fresh and flawy from northwest, gave an excellent opportunity to test her capacity to carry canvass.

* * * * *

I am, sir, very respectfully, your obedient servant,

FRANS. KEY MURRAY,

Lieutenant Commanding Steamer Jefferson.

Prof. A. D. BACHE,

Superintendent Coast Survey, Washington.

APPENDIX No. 55.

Report to the assistant in charge of the Coast Survey Office on the electrotyping operations of the Coast Survey, by George Mathiot, electrotypist.

ELECTROTYPE LABORATORY, COAST SURVEY OFFICE,

Washington, November 29, 1851.

DEAR SIR: In compliance with your request, I present the following report of the electrotpe art as now practised in this office. Most of the apparatus and processes here used are entirely new.

To clearly exhibit the advantages derived from their introduction, it will be necessary to consider the scientific principles involved in their use, and also to take a cursory view of the history of the electrotyping art.

The art of working metals by electric currents is of very recent introduction; and, although it has advanced with great rapidity, it is yet, perhaps, but in a state of infancy in its applications, and of crudeness in the modes of conducting it.

The electro-deposition of metals was observed by most experimenters with the voltaic battery. As early as 1804 electro-gilding had been successfully practised; but the idea of making castings by electric currents does not seem to have occurred to any one previous to the introduction of Daniel's battery, to which electro-casting is incidental.

After the introduction of Daniel's battery, it simultaneously occurred to several persons that electric currents might be used to make castings of a finer kind than were obtained by melting and pouring. Propositions to this effect are about all that can be attributed to the rival claimants for the invention of electro-metallurgy; for neither the English nor Russian philosopher revealed what had not been known before.

Yet to Jacobi and Spencer is due the merit of having called public attention to the subject; for in doing that, they have conferred benefits on the world greater, perhaps, than by making an original discovery.

After the publications of Jacobi and of Spencer had called the atten-

tion of the scientific world to the new art, the principles involved in it became the study of several eminent philosophers, who disclosed the methods to be followed for obtaining reguline metal. After this, several departments of electro-metallurgy rapidly advanced. Electroplating, and the multiplication of pages of letter-press work, as pages of type, and wood cuts, (electro-stereotyping,) were soon extensively practised; but the copying of the delicate touches of the copper-plate engraver (the electrotpe proper) was beset with difficulties. On account of the great value of the engraved plate, together with the risk of its being destroyed in the attempt to copy it, and the uncertainty as to whether the duplicate would have good metallic properties, even if the operator should have the good fortune to obtain one, this department of the art, (the first and most beautiful of Spencer's suggestions) was allowed to rest as an experiment or be confined to articles of small size and value.

Adhesion of deposite to matrix.

Electro-metallurgy requires that the deposited metal should have all its cohesive properties. If such a deposite of copper is made on a clean plate of copper, it is obvious that the deposited metal will cohere with the plate on which it is made, and an elaborately engraved plate would thus be converted into a mere mass of metal. The electrotpe art, therefore, cannot exist before means are provided for preventing this destructive adhesion.

Various plans for overcoming this difficulty have been proposed. All these, however, have a common feature, which is to prevent the deposite and matrix from touching by means of an intervening film of heterogeneous matter.

Mr. Smee proposes to use that coating of air which adheres so firmly to polished metals, (so strikingly exhibited when the attempt is made to wet a polished knife-blade.) To obtain the air coating, he directs that, after every attachment has been made to the plate, it be placed in a cool and moist cellar for a few days before introducing it into the electrotpe vat.

Smoke, black lead, oils, and powders, and wax, have also been proposed for covering the face of the plate.

The method used in the British ordnance survey is perhaps the best of all these. This is conducted as follows: The plate is first well oiled, and the oil well wiped away with soft bread. The plate is then heated to above the temperature of melting wax, and a cake of white wax pressed against the edge. The oil having removed the air from the plate, the wax will flash over it in an extremely thin sheet or film. All excess of wax is then to be wiped away with a fine linen cloth, free from lint. The plate must be left to cool before introducing it into the vat.

To smear the face of the finely engraved plate is in opposition to the fundamental idea of the electrotpe, which is that of atomic casting. In the process of Mr. Smee, air bubbles will be retained in the fine lines of the graving, thus mutilating the copy; moreover, the face of the new

plate is waved from the agitation of the stratum of air when receiving the first portion of copper.

In the waxing process it is almost impossible to free every line from excess of wax. Even days of tedious application do not insure perfection. In addition to the coarseness of these various methods, they are extremely uncertain as to whether they effect the purpose for which they are applied.

It was always observed that if the deposited metal was *not deficient* in mechanical properties, it stuck very hard to the original, and the plates had to be subjected to violent jarring, heating, and beating, to separate them. But if the deposited metal was of very fine quality, then most likely the deposit was inseparably united to it. From these circumstances attending the adhesion of the deposit, it occurred to me that, when the cohesive force was but feebly developed in the deposited metal, then the force of cohesion or homogeneous attraction could not extend the distance presented by the thickness of the film of heterogeneous matter between the plates; but that when these forces were well developed, the spheres of homogeneous attraction of each plate would extend through the wax or air film.

It may be proper here to remark that the above views of adhesion have been applied to another department of electro-metallurgy with the most gratifying success.

In electro-plating the difficulty of obtaining a firm adhesion of the film of precious metal is entirely obviated by making such arrangements as insure a rapid deposition of highly ductile metal at the moment the article to be plated is immersed in the electrotpe.

In considering the sticking of the plates, after homogeneous attraction or cohesion, heterogeneous attraction or adhesion demands attention; for two similar bodies may be separated by a film of heterogeneous matter, which binds them more firmly together than their particles are held together by cohesion, as we see in the use of cements.

This force is very powerful between some bodies, while between others it is very slight. Air adheres very strongly to metals, as before referred to; hence a film of air may unite two copper plates, even though they are separated beyond the distance at which cohesive attraction takes place.

Wax is a common ingredient in cements; its adhesive properties have become proverbial; its use is evidently improper. Therefore a substance having a strong adhesive attraction for the plates must not be on the face, and the cohesive force of the surface particles must be suspended by other methods than making the deposited metal deficient in mechanical properties.

It was hoped that a substance could be found that would act uniformly and gently on the surface of the engraved plate, and, in destroying the homogeneous attraction of the surface particles, would, by chemical union with them, form an insoluble and friable compound, having but a slight adhesion to the plate. I was led to select iodine for the experiment on account of its sparing solubility in water, its high equivalent number, and innoxious qualities. A copper plate was well cleaned, exposed to the vapor of iodine, and electrotyped; the deposit separated

from it readily. This was repeated some hundred times with invariable success.

It was found, in cleaning large plates for the application of the iodine vapor, that while one part of the plate was being cleaned, another part would tarnish, and hence a uniform action of the iodine could not be obtained. This led to silvering the plates before iodizing, which facilitated the cleaning and exhibited the action of the nalgén. A silvered plate was washed with an alcoholic solution of iodine and electrotyped; the electrotype separated from the matrix yet more readily than before, the iodide of silver serving better to prevent adhesion than the iodide of copper.

But it was soon observed that a plate prepared on a dull day did not separate so readily as one prepared under a bright sky, and on experimenting it was found that a plate iodized and exposed to sunshine would separate with very great facility; while a plate iodized on a rainy day, and placed in a dark room for a few hours before introducing it into the vat, might stick so hard as to require some of the old resorts of heating and jarring to separate it from the matrix.

The process of iodizing and exposing to light has now been applied to a very great extent of finely engraved surface, and in no case has the least difficulty been found in lifting one plate off the other when the requisite thickness had been obtained.

I am aware that it may be thought that the iodine acts only by intervening between the plates; but the quantity of iodine applied to a plate must be thought insufficient to effect it by mere mechanical separation when we consider the large quantity of silex and carbon found in ordinary copper. If but one ounce of copper be dissolved from a square foot of ordinary plate, a very heavy deposit of impurities is left, (sometimes 5 per cent.,) and the quantity of wax which may be applied to a plate, and fail to prevent sticking, is ten thousand times more than the quantity of iodine which prevents it.

In preparing our largest plates, having ten square feet of face, I use a solution of one grain of iodine in twenty thousand grains of strong alcohol. If one grain of the solution is required to wet a square foot, it will give but $\frac{1}{20000}$ of a grain of iodine on a square foot. But as the iodine evaporates rapidly with the alcohol, probably the actual quantity on a square foot does not exceed one-hundred-thousandth part of a grain.

Taking the weight of a cubic inch of iodine at 1,250 grains, and supposing that it remains on the silver surface in its elementary state, instead of forming iodide of silver, then we have $1,250 \times 144 \times 100,000 = 18,000,000,000$, only one-eighteen-thousand-millionth part of an inch for the thickness of the coating of iodine. Even if we suppose that the solar rays decompose the iodide of silver, and leave the iodine in vapor on the plate, it will still be only one-forty-four-millionth part of an inch—a thickness to be taken as nothing in a mechanical view.

To test the effect of the chemical method of preventing adhesion on the sharpness of the engraved lines, an engraving was seven times successively transferred from plate to plate, when the closest inspection failed to show any inferiority of impressions from the last plate as compared with those from the first.

Time and expense of electro-casting.

Next in importance to securing a certain and easy separation of the matrix and casting is bringing the entire time and expense of electrotyping within the narrowest limits.

Mr. Smee and others have shown that the quality of electro-metal is determined by certain relations between the rapidity of forming the plate and the strength of the solution in which it is formed. Both the common operations of the electro-metallurgist, and the improvements he proposes, must conform to these relations.

As small quantities of electricity are easily set in motion, small-sized electro-castings are readily made in six or eight days. To make large castings in a short time requires a powerful current. To accomplish the corresponding augmentation in the effective electric action has proved a somewhat difficult matter.

At the date of the "Aide Mémoire to the Military Sciences," it is stated that in the ordnance survey one pound of copper was deposited in twenty-four hours on a plate of eight square feet, the plates being made ductile enough to bear hammering only by continued agitation of the electrolytic solutions.

At this rate, to make a plate one-eighth of an inch thick will require forty-five days. So far as I am informed, the above performance has not been excelled, as to quality and time, on large work anywhere prior to being attained as now to be described.

The first and most obvious suggestion for increasing the rate of deposition is to enlarge the battery; this, however, is incapable of producing the desired end.

To present this subject in a clear and satisfactory manner, I will make use of the celebrated formula of Professor Ohm, who deduced from mathematical reasoning, and established by experiment, that the effective force of the current from any battery was directly as the electromotive force, and inversely as the resistance offered to that current.

To express this, he gave the equation $\frac{E}{R+r}=Q$, in which E represents the electromotive force, or affinity of acid for zinc, and $R+r$ the resistance to the current generated by that force; R representing the resistance offered to it from the liquid contained between the positive and negative elements of the battery, and r the resistance offered by the object on which the battery is working, and Q the amount of work executed, or the quantity of the current obtained.

The resistance of conductors has been found to be directly as the length, and inversely as the section.

So far as concerns form of arrangement, E is constant, for the materials used, as it depends on their chemical relations, Q can therefore be favorably affected only by varying R or r . Now, as R represents the resistance of the liquid contained between the battery plates, to increase the size of the plates is only to increase the section of the liquid, or, in other words, to diminish the resistance represented by R . The ex-

pression, $\frac{E}{R+r}=Q$, shows that, if the resistance in the battery is small

compared to the external resistance, the gain of effect from enlarging the battery plates is but small.

To determine the relative value of R , as compared with r , a battery was constructed so as to collect and measure the gas evolved by its action.

The plates were placed in contact with each other, and the gas evolved in thirty minutes taken as a unit of effect. As in this case the current did not pass through anything but the battery, there is no resistance to be represented by r , or r in the formula will be equal to 0

and $Q = \frac{E}{R} = 1.$

The battery was then attached to a pair of electrodes, in a certain solution of sulphate of copper and sulphuric acid, especially recommended by all the writers on electro-metallurgy, the arrangement being such as to produce good metal. The gas now evolved in thirty minutes was found only one-twentieth of the former amount; hence the introduction of the resistance, r , had diminished Q twenty times, and

$$\frac{E}{R+r} = Q = \frac{1}{20} \frac{E}{R}, \text{ whence } r \text{ is equal to } 19 R. \text{ To exhibit the effect of}$$

battery enlargement, we now have $Q = \frac{1}{\frac{1}{m} + 19}.$ If $m=1$, then $Q=.05$;

if $m=2$, $Q=.0512$; if $m=3$, $Q=.0518$; if $m=4$, $Q=.0524$, &c., &c.

This shows a gain of only a fortieth from doubling the size of the battery, &c.—an advantage too small to repay for the enlargement. These calculations are in accordance with experimental results from small batteries, but in large ones the necessity of further separating the plates, in increasing their size, makes the resistance increase, instead of diminish, and there is consequently a loss from enlargement. It is not, therefore, by merely increasing the battery surface that the time for electrotyping can be shortened.

Mr. Smee, the distinguished writer on electro-metallurgy, by covering the negative plate of the battery with pulverulent platinum, produced a very energetic form of the instrument. When the plate is freshly platinized, it acts violently, and throws off the hydrogen in torrents. But this increased energy of the plate is gradually lost, from the elective current depositing upon it impurities from the zinc.

As this deposit has a strong attraction for the hydrogen, it is retained on the plate. The plate, being thus encased in air, is virtually excluded from the liquid of the battery. The ordinary solvents of the metals do not readily remove this coating of impurity. The plate can be renewed by replatinization; but, as this is both tedious and expensive, I was urged to find a menstruum which would restore the original platinum to its energy. This I attained, at length, by immersing the plate in a solution of per-chloride of iron, which almost immediately restores the action of the plate.

The plates are now daily immersed in the chloride of iron, by which the tone of the battery is constantly maintained.

By this last discovery, together with obtaining better solutions for the decomposing cell, the time for making a casting was reduced; but still

the time required for making a plate was too long when only one electrical equivalent was employed.

The effective force of one battery may be added to another. This is increasing E in the formula, and this will sometimes increase Q .

We unite the effective force of many batteries by joining their dissimilar ends in consecutive order. As the current in such an arrangement has to traverse every battery in the chain, R will be multiplied as many times as we multiply E . The formula then becomes $Q = \frac{n E}{n R + r}$. When the

value of r and R are nearly equal, and we have batteries of definite construction to work with, it becomes a matter of some importance to determine whether we shall use the whole galvanic apparatus, as a single electrical equivalent, by connecting all the similar parts of all the battery cells, or whether we shall convert it into a battery of two pairs, in consecutive order, by joining dissimilar ends. As doubling the battery is doubling R , and to double the electrical equivalents is also to double R , we shall increase R fourfold by the double arrangement.

Instead of $Q = \frac{E}{R+r}$ we have $Q = \frac{2 E}{4 R+r}$. Taking $R=r$ we have

$Q = .50$ in the single arrangement, and $Q = .40$ in the double—showing that we may double the expense, and yet make the casting more slowly than before. Conditions as above are of frequent occurrence, and a knowledge of them without experimenting is of very great importance.

For $R = 10 r$, with a single equivalent of battery, $Q = \frac{1}{1+10} = 0.0909$.

For two batteries in series $Q = \frac{2}{2+10} = 0.166$. The use of two batte-

ries in consecutive order, as thus exhibited, doubles the expense, but does not double the effect. A regard for economy prohibits us from further increasing the series. To represent an effect double of $\frac{E}{R+r}$ we have

$2 \left(\frac{E}{R+r} \right) = \frac{2 E}{\frac{2 R+r}{2}}$. As dividing R by 2 is doubling the battery

surface, we may now make $Q = .183$. The gain per cent., now indicated by doubling the surface, makes it advantageous to make this increase when two consecutive batteries are used.

The difficulty of obtaining large flat plates of silver proved a serious obstacle in effecting an increase of battery surface, for the irregularity of the surface requires the plate to be placed at an increased distance from the zinc, thereby augmenting R , the very thing sought to be diminished.

Plates could be made flat by the planishing hammer; but the operation being expensive, and the plates continually liable to accidents in use, economy prohibited this mode of forming flat plates. Though the plating of metallic bodies with silver had been well executed, it had not yet been determined that electro-casting of silver could be executed

in a desirable manner, and at a moderate expense and trouble. At first, every attempt to make plates weighing 2,500 grains to the square foot failed, on account of the impossibility of observing Mr. Smee's laws relative to E for the time required.

But after modifying the solutions of silver, and using a register battery, a plate could be made in thirty hours, perfectly flat, and possessing the mechanical qualities of hardness, elasticity, and malleability, in an eminent degree, and not costing over 16 cents per ounce for the making.

The perfectly flat plates admit of a very close approximation to the zincs. Their size may therefore be increased to more than twice their former surface. As in the double arrangement, r is relatively smaller to R .

Important changes have also been made in the modes of operating, and in the arrangement of the apparatus. It had early been noticed that changes of temperature influenced the rate of working; and every electro-metallurgist knows the importance of keeping the laboratory warm.

To determine where and how the effect of temperature took place, a battery, at 60 degrees of Fahrenheit, was connected with a wire 120 feet long, and enclosing a galvanometer. The deflection was 40 degrees; the battery was then cooled until the temperature was 48°; the needle was still deflected nearly 40 degrees.

This experiment indicated that the batteries were not greatly affected by ordinary variations of temperature. Advantage was then taken of this development to secure a more perfect ventilation. Accordingly, a small room, to contain the battery, was partitioned off from the general apartment by a glass partition, and large outward openings made at the top and at the bottom of the room, to give a circulation of air for carrying off the battery fumes.

At the stage of improvement now described, one of our medium plates, having 8 square feet of surface, could be readily made in from 8 to 10 days. But wishing to still further quicken the process, or attain my first desire—to deposit one pound per day on the square foot, with a single equivalent of battery—improvements were again sought after. As the E of the formula has been increased to the greatest extent the cost would permit, and r had been diminished, or the plates increased in size to the greatest useful extent, it was sought to increase Q by diminishing r , or the electrolytic resistance. It was sought to increase the conducting power of the electrolyte by adding easily decomposable salts to it; but with no success. The accelerating effect of temperature being found, as above stated, to be confined chiefly to the decomposition cell, it was evident that by using the electrolyte alone, at a high temperature, a considerable advantage might ensue.

To determine the most advantageous working temperature, and the resulting gain of effect, a voltameter battery was connected to a pair of electrodes, in the solution formerly described as being generally recommended. Each electrode had five square inches of face, and was coated on the back to prevent radiation. They were placed one inch apart, and had thin plates of wood bound against their edges, to prevent any lateral spread of the current in passing between them. The following was then obtained:

Battery plate in contact gave 300 cubic inches gas per hour.						
Electrodes in contact	do.	216	do.	do.	do.	
Current through electrolyte, at 58°						gave 16 cubic in. gas per h. 23.15
Do.	do.	60°	do.	20	do.	do. 18.15
Do.	do.	100°	do.	27	do.	do. 13
Do.	do.	175°	do.	37	do.	do. 8.96

The last column of figures shows the value of the resistance of the solution, as compared with R of the formula. This column was obtained by first uniting the battery plates, and afterwards the electrodes.

From the above table it appears that heat may be made to diminish the resistance in the decomposition cell in the proportion of 2.58 to 1;

and the whole resistance by 2.25. And as $\frac{2E}{R+r} = \frac{E}{R+r};$ therefore, by

heating the electrolyte, we may with a single electrical equivalent make a plate as rapidly as by working at atmospheric temperatures with two batteries in consecutive order, with double surfaces, (four times the battery and twice the expense.)

But as Smee's laws require that, in forming a plate, certain mutual conditions of apparatus be maintained, it follows that alterations in one element or condition must be attended by corresponding changes in the others. Hence, if the temperature of the electrolyte be raised to a certain point, and the apparatus correspondingly adjusted, it is evident that, to avoid incessant adjustment, the original temperature must be maintained.

Thus, to avail ourselves of the advantages experimentally found from heating the solutions, an apparatus for steadily maintaining a high temperature in the electrolyte through several successive days becomes indispensable.

As the electrotpe operations are not suspended at night, it is important that the heating apparatus should perform its office for at least twelve hours without supervision or replenishing its fuel; and its action should be sensibly uniform, during all the time, between successive replenishings.

Such an apparatus I have devised, and is now in use. A peck of charcoal furnishes fuel for twelve hours, and maintains 100 gallons of copper solutions steadily, at any required point between 100° and 200°.

With the above arrangement in use, I have made a large reverse or alto, and returned the original to the engraving department, in 55 hours from its being placed in my hands. This time included trimming the edges and the preparations to prevent adhesion.

Again recurring to Ohm's formula, the relative value of R to r was once more experimentally found. This gave $R : r :: 1 : 4$ or

$Q = \frac{1}{1+4} = 0.20$, a great improvement as compared with the first deter-

mination of $R : r :: 1 : 19$, or $Q = \frac{1}{1+19} = 0.05$. Having now made r so

small compared with R , the size of the battery can be profitably increased until the result is about 0.24. Moreover, using a double arrangement

compared to the external resistance, the gain of effect from enlarging the battery plates is but small.

To determine the relative value of R , as compared with r , a battery was constructed so as to collect and measure the gas evolved by its action.

The plates were placed in contact with each other, and the gas evolved in thirty minutes taken as a unit of effect. As in this case the current did not pass through anything but the battery, there is no resistance to be represented by r , or r in the formula will be equal to 0

and $Q = \frac{E}{R} = 1.$

The battery was then attached to a pair of electrodes, in a certain solution of sulphate of copper and sulphuric acid, especially recommended by all the writers on electro-metallurgy, the arrangement being such as to produce good metal. The gas now evolved in thirty minutes was found only one-twentieth of the former amount; hence the introduction of the resistance, r , had diminished Q twenty times, and

$$\frac{E}{R+r} = Q = \frac{1}{20} \frac{E}{R}, \text{ whence } r \text{ is equal to } 19 R. \text{ To exhibit the effect of}$$

battery enlargement, we now have $Q = \frac{1}{\frac{1}{m} + 19}$. If $m=1$, then $Q=.05$; if $m=2$, $Q=.0512$; if $m=3$, $Q=.0518$; if $m=4$, $Q=.0524$, &c., &c. This shows a gain of only a fortieth from doubling the size of the battery, &c.—an advantage too small to repay for the enlargement. These calculations are in accordance with experimental results from small batteries, but in large ones the necessity of further separating the plates, in increasing their size, makes the resistance increase, instead of diminish, and there is consequently a loss from enlargement. It is not, therefore, by merely increasing the battery surface that the time for electrotyping can be shortened.

Mr. Smee, the distinguished writer on electro-metallurgy, by covering the negative plate of the battery with pulverulent platinum, produced a very energetic form of the instrument. When the plate is freshly platinized, it acts violently, and throws off the hydrogen in torrents. But this increased energy of the plate is gradually lost, from the elective current depositing upon it impurities from the zinc.

As this deposit has a strong attraction for the hydrogen, it is retained on the plate. The plate, being thus encased in air, is virtually excluded from the liquid of the battery. The ordinary solvents of the metals do not readily remove this coating of impurity. The plate can be renewed by replatinization; but, as this is both tedious and expensive, I was urged to find a menstruum which would restore the original platinum to its energy. This I attained, at length, by immersing the plate in a solution of per-chloride of iron, which almost immediately restores the action of the plate.

The plates are now daily immersed in the chloride of iron, by which the tone of the battery is constantly maintained.

By this last discovery, together with obtaining better solutions for the decomposing cell, the time for making a casting was reduced; but still

the time required for making a plate was too long when only one electrical equivalent was employed.

The effective force of one battery may be added to another. This is increasing E in the formula, and this will sometimes increase Q .

We unite the effective force of many batteries by joining their dissimilar ends in consecutive order. As the current in such an arrangement has to traverse every battery in the chain, R will be multiplied as many times as we multiply E . The formula then becomes $Q = \frac{n E}{n R + r}$. When the

value of r and R are nearly equal, and we have batteries of definite construction to work with, it becomes a matter of some importance to determine whether we shall use the whole galvanic apparatus, as a single electrical equivalent, by connecting all the similar parts of all the battery cells, or whether we shall convert it into a battery of two pairs, in consecutive order, by joining dissimilar ends. As doubling the battery is doubling R , and to double the electrical equivalents is also to double R , we shall increase R fourfold by the double arrangement.

Instead of $Q = \frac{E}{R+r}$ we have $Q = \frac{2 E}{4 R+r}$. Taking $R=r$ we have

$Q = .50$ in the single arrangement, and $Q = .40$ in the double—showing that we may double the expense, and yet make the casting more slowly than before. Conditions as above are of frequent occurrence, and a knowledge of them without experimenting is of very great importance.

For $R = 10 r$, with a single equivalent of battery, $Q = \frac{1}{1+10} = 0.0909$.

For two batteries in series $Q = \frac{2}{2+10} = 0.166$. The use of two batte-

ries in consecutive order, as thus exhibited, doubles the expense, but does not double the effect. A regard for economy prohibits us from further increasing the series. To represent an effect double of $\frac{E}{R+r}$ we have

$2 \left(\frac{E}{R+r} \right) = \frac{2 E}{\frac{2 R+r}{2}}$. As dividing R by 2 is doubling the battery

surface, we may now make $Q = .183$. The gain per cent., now indicated by doubling the surface, makes it advantageous to make this increase when two consecutive batteries are used.

The difficulty of obtaining large flat plates of silver proved a serious obstacle in effecting an increase of battery surface, for the irregularity of the surface requires the plate to be placed at an increased distance from the zinc, thereby augmenting R , the very thing sought to be diminished.

Plates could be made flat by the planishing hammer; but the operation being expensive, and the plates continually liable to accidents in use, economy prohibited this mode of forming flat plates. Though the plating of metallic bodies with silver had been well executed, it had not yet been determined that electro-casting of silver could be executed

in a desirable manner, and at a moderate expense and trouble. At first, every attempt to make plates weighing 2,500 grains to the square foot failed, on account of the impossibility of observing Mr. Smee's laws relative to E for the time required.

But after modifying the solutions of silver, and using a register battery, a plate could be made in thirty hours, perfectly flat, and possessing the mechanical qualities of hardness, elasticity, and malleability, in an eminent degree, and not costing over 16 cents per ounce for the making.

The perfectly flat plates admit of a very close approximation to the zincs. Their size may therefore be increased to more than twice their former surface. As in the double arrangement, r is relatively smaller to R .

Important changes have also been made in the modes of operating, and in the arrangement of the apparatus. It had early been noticed that changes of temperature influenced the rate of working; and every electro-metallurgist knows the importance of keeping the laboratory warm.

To determine where and how the effect of temperature took place, a battery, at 60 degrees of Fahrenheit, was connected with a wire 120 feet long, and enclosing a galvanometer. The deflection was 40 degrees; the battery was then cooled until the temperature was 48°; the needle was still deflected nearly 40 degrees.

This experiment indicated that the batteries were not greatly affected by ordinary variations of temperature. Advantage was then taken of this development to secure a more perfect ventilation. Accordingly, a small room, to contain the battery, was partitioned off from the general apartment by a glass partition, and large outward openings made at the top and at the bottom of the room, to give a circulation of air for carrying off the battery fumes.

At the stage of improvement now described, one of our medium plates, having 8 square feet of surface, could be readily made in from 8 to 10 days. But wishing to still further quicken the process, or attain my first desire—to deposit one pound per day on the square foot, with a single equivalent of battery—improvements were again sought after. As the E of the formula has been increased to the greatest extent the cost would permit, and r had been diminished, or the plates increased in size to the greatest useful extent, it was sought to increase Q by diminishing r , or the electrolytic resistance. It was sought to increase the conducting power of the electrolyte by adding easily decomposable salts to it; but with no success. The accelerating effect of temperature being found, as above stated, to be confined chiefly to the decomposition cell, it was evident that by using the electrolyte alone, at a high temperature, a considerable advantage might ensue.

To determine the most advantageous working temperature, and the resulting gain of effect, a voltameter battery was connected to a pair of electrodes, in the solution formerly described as being generally recommended. Each electrode had five square inches of face, and was coated on the back to prevent radiation. They were placed one inch apart, and had thin plates of wood bound against their edges, to prevent any lateral spread of the current in passing between them. The following was then obtained:

Battery plate in contact gave 300 cubic inches gas per hour.						
Electrodes in contact	do.	216	do.	do.	do.	
Current through electrolyte, at 58°						gave 16 cubic in. gas per h. 23.15
Do.	do.	60°	do.	20	do.	do. 18.15
Do.	do.	100°	do.	27	do.	do. 13
Do.	do.	175°	do.	37	do.	do. 8.96

The last column of figures shows the value of the resistance of the solution, as compared with R of the formula. This column was obtained by first uniting the battery plates, and afterwards the electrodes.

From the above table it appears that heat may be made to diminish the resistance in the decomposition cell in the proportion of 2.58 to 1;

and the whole resistance by 2.25. And as $\frac{2E}{R+r} = \frac{E}{\frac{R+r}{2}}$; therefore, by

heating the electrolyte, we may with a single electrical equivalent make a plate as rapidly as by working at atmospheric temperatures with two batteries in consecutive order, with double surfaces, (four times the battery and twice the expense.)

But as Smee's laws require that, in forming a plate, certain mutual conditions of apparatus be maintained, it follows that alterations in one element or condition must be attended by corresponding changes in the others. Hence, if the temperature of the electrolyte be raised to a certain point, and the apparatus correspondingly adjusted, it is evident that, to avoid incessant adjustment, the original temperature must be maintained.

Thus, to avail ourselves of the advantages experimentally found from heating the solutions, an apparatus for steadily maintaining a high temperature in the electrolyte through several successive days becomes indispensable.

As the electrotype operations are not suspended at night, it is important that the heating apparatus should perform its office for at least twelve hours without supervision or replenishing its fuel; and its action should be sensibly uniform, during all the time, between successive replenishings.

Such an apparatus I have devised, and is now in use. A peck of charcoal furnishes fuel for twelve hours, and maintains 100 gallons of copper solutions steadily, at any required point between 100° and 200°.

With the above arrangement in use, I have made a large reverse or alto, and returned the original to the engraving department, in 55 hours from its being placed in my hands. This time included trimming the edges and the preparations to prevent adhesion.

Again recurring to Ohm's formula, the relative value of R to r was once more experimentally found. This gave $R : r :: 1 : 4$ or

$Q = \frac{1}{1+4} = 0.20$, a great improvement as compared with the first deter-

mination of $R : r :: 1 : 19$, or $Q = \frac{1}{1+19} = 0.05$. Having now made r so

small compared with R , the size of the battery can be profitably increased until the result is about 0.24. Moreover, using a double arrangement

of cells with double surfaces, for a double effect, we now have $2 \left(\frac{1}{1+4} \right) = \frac{2}{2+4} = 0.40$. As the relative resistance of the electrolyte becomes now still smaller, we may yet more increase the battery surface until the result is nearly 0.5.

The electrotpe has now ceased to be a mere experiment, uncertain, expensive, and slow. I have lately formed plates of most excellent quality, at the rate of 3 lbs. to the square foot, in 24 hours. This rate will require but two days to form one of our largest plates, having ten square feet surface, and one-eighth of an inch thick.

Actions in the electrolytic solution.

The quantity of the deposited metal is governed solely by the relations between the *quantity* of electricity passing through any solution and the amount of metal the solution contains. The usual supposition is, that the acid of the salt goes to one electrode and the metal to the other. It is now ascertained that no such mutual transfer takes place; for, while the acid is carried to the positive electrode, the metal is *not* carried to the negative electrode. Hence, however strong the solution on commencing the process, the negative electrode, by abstracting the metal in its vicinity, is soon surrounded with a weak solution. With a simple wire electrode, the exhausted solution surrounding the electrode is readily renewed by mere difference of specific gravity producing a flow. But, with large parallel plate electrodes, this rapid renewal of dense solution becomes impossible, and the electrode is soon surrounded with a weak solution. This state of things must be recognised in adjusting our battery arrangements. Electrotypists not aware of this fact find themselves much perplexed by failing to accomplish with large plates what is so easily done with medals or small plates.

It would, at first sight, appear that, by strengthening the solution of sulphate of copper, a more rapid supply of metal to the electrode would be obtained. Unfortunately, the effect of this is to diminish the solvent capacity of the water in the solution for the sulphate formed on the positive electrode by the action of the transferred acid. The grand essential in electrolysis is liquidity in the solution. Thus, if the quantity of free water surrounding the positive electrode be small, this electrode is soon enveloped in a saturated solution, and the newly-formed salt remains undissolved upon it. This salt, being a non-conductor, virtually excludes the electrode from the solution, and thus arrests the current, except when the efflux of saturated solution permits the salt to dissolve, and so reopens the passage for the current in irregular quantities. From this spasmodic action result plates of copper-sand, or sometimes copper as soft as lead.

By applying heat to the solution when this state of things exists, the solvent capacity of the water for the salt is increased, rapid diffusion takes place, the salt is carried to the negative electrode, and the exhausted water to the positive electrode; the dormant batteries rush into uninterrupted action, and in a short time a plate is deposited, having all the hardness and elasticity of hammered or rolled copper. Smee's conditions, then, seem to maintain themselves. The electrotypists'

axiom of "work slowly," requires to be reversed into "the quicker the work, the better the quality."

Laboratory apparatus.

Figure I is a plan of the coast survey electrotype laboratory. The glazed partition, *b, b, b, b*, with a door, *d*, separates the battery room from the general laboratory, and permits an easy inspection of the batteries, without exposure to their fumes. The laboratory floor is about six feet above the ground, and slopes inward from the sides towards the scuttle holes, *h, h, h, h*, arranged for discharging the waste liquids spilled upon the floor. To obviate the deleterious effects of working on a floor saturated with chemical agents, when any solutions are spilled, the floor is well flooded and brushed, the water passing off through the scuttle holes. There are four battery cells, placed as indicated, *B, B, B, B*. A rectangular India-rubber bag, supported by a deep wooden box, contains the battery solutions. Each cell can contain nine silver and eight zinc plates. A metallic connexion unites all the zinc plates of a cell, and another one all the silver plates. Each cell can be used as an independent battery, or two, three, or four cells can be connected in consecutive or simultaneous order, or all combined into two pairs of two in consecutive or simultaneous order, or into one group of three and one of one. The position of the vertical decomposing vat is shown at *V*, and that of the horizontal vat at *H*. *S* is a large tub for washing plates. The tub *C* contains the solution of chloride of iron. *Q* is the quicksilver tub, and *W, W*, are fresh water tubs. *F* is the furnace, and *d, d, c, c*, are heating tubes connecting with the vat *H*. *T* is a flat iron table.

Fig. 2 exhibits a cell and its included plates, with their mode of suspension.

Fig. 3 represents the suspending frame of wood and the attached plate, *P*, prepared for immersion in the vertical vat.

Fig. 4 shows the vertical vat and the plates suspended in it.

Fig. 5 represents the adjustable plate-supporting frame used in the horizontal vat.

Fig. 6 exhibits the interior arrangement of the horizontal vat, a blank plate and an engraved original being in position; also the connecting copper wires leading to the battery.

Fig. 7 represents the heating furnace. The door for admitting air is shown at *a*, and is so connected with an adjusting compound bar of iron and zinc that by an adjusting screw it can be arranged to regulate the draught, opening or closing the door, thus maintaining a uniform heat in the solution. After getting the fire started, this door is set so as to close when the solution reaches a heat of 150° . In principle this furnace is similar to a bath-heater. A tubular helix of lead is coiled within it like the worm of a still, and the terminating branches *c* and *d* lead to the horizontal vat, the branch *c* uniting the top of the vat just below the liquid surface with the bottom of the coil, and *d* the bottom of the vat with the top of the coil. Hence follows a circulation of the solution from the furnace at top and into it at bottom.

Manipulation.

When a plate is to be electrotyped, it is placed on trestles above the open scuttle holes, *h, h, h, h*, and thoroughly cleaned by washing with alkalies and acids. It is then silvered, iodized, and placed before a window. A plate of rolled copper an inch larger than the engraved plate is then selected, placed on the flat iron table, and beaten with mallets until a steel straight edge shows it to be plane. It is then weighed and fixed in the vertical plate frame by two copper hooks. The engraved plate is then similarly fixed in a similar frame, when both are placed in a vertical vat and connected with the battery.

The process does not go on well when the plates are vertical, but it is necessary to start the castings in this position to prevent dust, motes, or specks of impurities, from settling on the face. As the rolled plate dissolves, its impurities rapidly render the solution muddy, and endanger the face of the forming plate. For common electrotypes dust or mote specks are not detrimental; but the coast survey copper plates being not inferior in fineness of lines to fine steel plates, the effect of impurities settling on the face of their copies is to give the impressions a clouded appearance. On first immersing the plate, the solution should, therefore, be perfectly clean. Formerly, after each use of the vertical vat, it was emptied and washed out. When the solution had deposited its sediment it was drawn off and strained through very fine cotton. This whole operation was extremely disagreeable, and consumed a whole day of one man.

By a simple expedient I have saved the necessity of cleaning the vat oftener than once a month. To guard the new plate from specks and impurities, a bag of fine cotton is drawn over a slight wooden frame, which keeps it distended. An hour or more before the solution is wanted, the bag, with its included frame, is placed on top of the solution and loaded with the copper bars used to support the plate frames. The weight causes the bag to sink gradually, filtering the contained solution as it goes down. The impurities cannot wholly choke the meshes of the cloth, as a fresh portion is constantly brought into action during the sinking. I thus filter the solution without taking it from the vat or disturbing the sediment, saving much labor, time, and annoyance.

The plate remains in the vertical vat over night, and preparations are made in the morning to transfer it to the horizontal vat. The furnace is first brought into action. A new plate of blank copper, an inch larger than the matrix, is flattened on the iron table, and bolted to the edges of wooden bars by platinum bolts, for the purpose of preventing the plate from sagging downwards when supported horizontally. The plate so arranged is called the strapped plate. The coated matrix is then taken from the vertical vat, disengaged from its frame, and arranged in the horizontal frame. A wooden wall, an inch high, then surrounds the plate, and in this wall the strapped plate is laid, when the whole combination is placed in the horizontal vat and the connexion with the battery established. The positive plate is then taken from the vertical vat and its loss of weight noted and recorded. From the known superficial area of the matrix, the quantity of copper required for a casting one-eighth of an inch thick is computed and recorded. The

blank copper consumed in both vats must equal this amount before the required thickness is reached, allowance being made for impurities of rolled copper and roughness on the back of the electrotpe. After a few hours of action the strapped plate becomes so loaded with impurities that they will begin to drop on the electrotpe; this plate must, therefore, be removed from the vat and a new one immediately supplied. The dirty plate is then washed in the large water tub, and when cleaned its loss of weight is found and recorded. By the amount of loss the action of the batteries is tested, and it is found, if Smee's laws are being observed. Vigilance must now be exercised in watching the batteries and rate of work, and the power must be varied to suit circumstances.

The entire working battery generally requires renewal once a day, the process being conducted as follows: One zinc and one silver plate are taken from the battery; the silver placed in the solution of chloride of iron, and the zinc taken to the water tub outside the door of the battery room, where it is scrubbed clean with a hard brush. It is then re-amalgamated at the quicksilver tub, and taken back to the battery. The silver plate is transferred from the chloride of iron solution to the adjacent fresh water tub. Another silver plate is then transferred from the battery to the chloride solution, and another zinc cleaned, washed, and put back in the battery with the first silver. In this manner the whole battery can be renewed without sensibly interrupting its action.

When the loss of weight from the rolled copper in both vats indicates that the required thickness of the electrotpe is gained, the plate is withdrawn from the battery, detached from its frame, its back smoothed, and its edges filed, until a separation can be made. By separation, the original becomes liberated, and the alto or reversed relief is silvered and electrotped exactly as an original. The copy from it, or the electrotped basso, will, if the process has been properly conducted, be a perfect fac-simile of the original, and in hardness, ductility, and elasticity, will equal the best rolled and hammered or planished copper plate.

Yours, respectfully,

GEORGE MATHIOT.

Major I. I. STEVENS,

Assistant in charge of office.

APPENDIX No. 56.

Report of Lieutenant Washington A. Bartlett, U. S. N., assistant in the coast survey, to the Superintendent, on the examination of the reefs in Hell Gate channel, and changes produced by blasting.

NEW YORK, December 4, 1851.

DEAR SIR: In my previous reports on the improvements being made in Hell Gate channel, by the operations of Mons. Maillefert, facilitated by advances from citizens of New York, I have endeavored to keep you advised of the progress of the work, and its probable effect in improving this important channel of ingress to New York harbor.

I am now enabled to lay before you *results actually* obtained, which

have substantially improved the navigation of the "Gate;" reduced the risk of passing through it; and which will very considerably modify the sailing directions which appear on the first edition of the coast survey chart of *Hell Gate*, and its approaches.

Referring to the reports made to you by Lieutenant Commanding Chas. H. Davis, United States navy, on the 15th February, and of Lieutenant Commanding D. D. Porter, on the 30th of October, 1848, the great advantages which they so ably discussed, and so confidently expected would ensue when the effort should be made as proposed, I am happy to say are now being realized.

A close attention to all they suggested as the basis of operations, and the exertions of Mr. Maillefert and Mr. Eben Meriam, based on those reports and surveys, have most conclusively demonstrated to me—so far as the work has progressed—the clear perceptions of those able officers in their suggestions for the improvement of the channel.

It only required Mr. Maillefert's effective method of overcoming the local difficulties involved in any attack on Pot rock to make the work effective. The results are altogether favorable. * * *

The first in order, and the principal obstruction in Hell Gate, is *Pot rock*, on which I found but eight feet of water at low tide; the average depth, however, was about ten feet; the rock at the least depth being about six feet square, deepening to fourteen feet on the east and west sides, and suddenly to four fathoms on the north and south. * *

At half tides the depth of water does not increase on Pot rock, as there is at least a fall of *four feet*, and a vessel drawing over eight feet must strike upon it. "A full-rigged brig struck it three days since, and went down with a valuable cargo on board."

This obstruction once removed, Hell Gate would be less dangerous by one-half, "and the eddies, which are now the cause of half the difficulties, would in a measure disappear."

I have quoted as above Lieutenant Commanding Porter, United States navy, for the purpose of saying that his observations have been most fully sustained by the present condition of *Pot rock*, and that the vast—I might almost say the incalculable advantages to be derived for all future time from the reduction of this rock, cause it to be considered by all who have occasion to pass through this channel as of inestimable value.

It cannot now be said that a vessel drawing only eight feet of water will strike, *for there are not less than eighteen feet* water on any part of the rock at low tide; and the prospect is highly favorable to the belief that M. Maillefert will soon have lowered it to twenty feet, a depth which in my opinion is amply sufficient for all the requirements of the Hell Gate channel.

The advantages derived from the increased depth of water on *Pot rock* are as follow:

1st. Vessels drawing sixteen feet water can pass over it with impunity at any time of tide, and any frigate in the navy can do so at *high water*.

2d. The increased facility for the passage of the rapid current of the flood-tide over the top of Pot rock prevents that high and violent ebullition of the water which formerly existed to the imminent danger of all

small vessels (though they might not hit the rock itself) which were thrown within its influence; while it prevents that rapid eddy, or *return current*, which formerly existed, and which threw all boats or "small craft" which once entered it into the very centre of the "Pot," and then engulfed them.

The dangers to be apprehended from these causes (or if averted, encountering others in avoiding them) compelled all mariners to so direct their course through the Gate as to give the "Pot" as wide a berth as possible; and this wide steering again produced other difficulties equally attributable to it, but which otherwise could be easily avoided. Lieutenant Commanding Porter justly said that, "*Pot rock* once removed, Hell Gate would be less dangerous by one-half, and the eddies, which are now the cause of half the difficulties, would in a measure disappear."

The sketches which have been furnished of my examinations of *Pot rock*, during the progress of its demolition, have shown that it is at a mean depth of twenty feet at low water, one hundred and thirty feet in length, and thirty feet in *average* width. Before blasting, the least depth extended over a surface six feet square, while the average depth (*vide* Lieutenant Porter's report) was about ten feet. With these facts before me, I have estimated that not less than (30,000) thirty thousand cubic feet of rock (hard gneiss) have been broken up, and scattered from the upper portions of the rock, by firing two hundred and twenty sub-marine charges, of one hundred and twenty-five pounds each, *without drilling*. This is equal to one hundred and thirty-five cubic feet of rock being removed at each blast; which calculation agrees remarkably well with the effect of *each* blast at Pot rock, and other points where I have examined for facts.

If it had required a pound of powder to a *pound of rock*, it would be a *cheap* process at Pot rock; for it is not easy to conceive how this very troublesome obstruction could have been so far demolished by any other mode than that used. The strength of the current is an effectual opponent to any drilling, even supposing it possible, by successfully anchoring a *float*, the position could be maintained. It was ably attempted and signally failed. The few moments at slack water are not sufficient to find the drilling point, and only sufficient for firing two or three charges, previously arranged for firing, *without drilling*.

In another part of the report of Lieutenant Commanding D. D. Porter, he states to you as follows: "There is a small, though very dangerous rock to the southward of Woolsey's bath-house. It extends about fifty yards out into the channel, and is connected with the shore-line at low water. There are three feet of water on it at high tides. On the first of the flood, a buoy, let go opposite 'Gibbs's point,' (the southern approach to Hell Gate,) drifted round Hallett's point, between Pot rock and Way's reef, along the edge of the eddies, and over the above-mentioned rock, into 'Pot cove.' This happens to a great many vessels, and, but for this dangerous obstruction, they would drift into a safe harbor."

I have now the pleasure to report that this rock, so well described by Lieutenant Porter, and so dangerous that I have seen two vessels bilge on it within a single hour, and still another rock, which, though

not mentioned by him, lies a few yards from it, and nearly as dangerous and destructive, *have been entirely destroyed, annihilated by submarine explosions, without drilling*, since the 7th of November, and there are now not less than seven feet water at low tide where they existed, or the usual depth of water on the *shelving shore-line*.

These two rocks have been, for all the past time, very destructive to vessels attempting to pass the south shore, or in anchoring near it, when they were covered, which was most of the time; and any vessel once in the Pot Eddy in a calm was almost certain to hit one or the other of them. Three schooners have bilged on them this autumn. They no longer exist, and, if nothing else had been done to improve Hell Gate, their destruction is worth ten times the amount of money expended by the citizens in this enterprize.

Should masters of vessels now desire to anchor near the bluff to the southward of Woolsey's bath-house, they can do so without the risk of having their keels or rudders knocked out by the current swinging them on those rocks.

They can be erased from your next edition of the chart of Hell Gate.

Cram's rock, or rather the rock which lies *twenty-seven yards* from the end of Cram's dock, with a clear channel between it and the dock, as also "*Scaley rock*" and "*Shell rock*," it is hoped, will be destroyed shortly, as they are always dangerous to vessels when the tide is above the half. The same can be said of the rock off "Negro point," "Bald-headed Billy,"* and "Blackwell's rock."

Cram's rock is in area ten by fifteen feet and ten feet high, (or above the bottom,) and covered at high water.

A few hundreds of pounds of powder will remove them all, and their destruction will save hundreds of thousands of dollars to the coasting trade.

My experience at *Hell Gate* during the past four months has shown me, in a strong light, (and I desire particularly to call your attention to it,) the force of the remark in Lieutenant Commanding Porter's report, already referred to, where he says: "If any attempt is made to carry out the recommendations that have been frequently made relative to clearing away rocks in Hell Gate, I would suggest a close examination of the shore-line at low water. Many rocks will be found to exist of a dangerous character, and they have at different times done much damage to vessels of light draught." He might have said, with equal propriety, that they are *continually doing damage*.

M. Maillefert has fired several discharges on the Frying-pan rock; but as the work is in progress, I shall not examine it till he closes for the season.

May's reef has also been the object of attack, as opportunity offered, and you have before you my careful examination of it in sections of three feet. As both these last-named dangers are in progress of removal, I shall not make further reference to them in this report. We have placed buoys at their extremities, which indicate their positions to navigators, and they are thus able to avoid them.

I must remark here that I have observed that, though most naviga-

* Removed Dec. 4, 1851.

tors knew certain marks for *avoiding* these hidden dangers of the Gate, very few indeed of the many who pass the Gate have had any clear idea of their *exact localities* until they witnessed the operations there.

Referring again to the able reports of Lieutenants Davis and Porter, I can only add, that it appears strange, indeed, that this great national thoroughfare should have been so long neglected by the country; for I cannot hesitate to say, that it often happens that there are not less than *two hundred* sail of vessels and steamers passing, or attempting to pass, *Hell Gate* at the same time, and all in this narrow channel of less than three miles in length.

A small amount of money for labor and contingent expenses, or two officers and ten men, with "*carte-blanche*" at a powder-mill, are all that are required to clear the navigation from Governor's island to Throg's neck; and there is no part of the navigable waters of the United States which requires it more.

The happy results of the operations in the Gate prove conclusively what was only speculation until attempted; and it is to be hoped that this good work will not stop for want of the trifling means to carry it on.

Numerous masters of the coasting trade have expressed to me their extreme gratification in the results already obtained; and, such is their anxiety to have it go on, that they would be willing to be taxed for every passage through the Gate if the dangers were removed.

The propriety of the work is too apparent, in the vastly growing commerce, by sail and steam, of this great city, to require any argument in its support. In conclusion, I beg leave to state, that to Eben Meriam, esq., is justly due the credit (and it is not a small matter) of interesting (by the aid of the reports in the coast survey office) the wealthy merchants of this city in this matter, and procuring from them the advances necessary for the experiment of this attempt at improvement in Hell Gate.

I deem it also proper to state, that M. Maillefert, the ingenious and enterprising operator in submarine blasting *without drilling*, exhibits the most ardent desire to serve the public to the utmost of his ability, preferring the *credit of success* in his novel mode of operation to any pecuniary benefit; and, notwithstanding all he has done, he will be a considerable *loser* in money, unless the benefits of his enterprise shall successfully appeal for his reimbursement.

I would remark, for your information, that the destruction of the two rocks, so troublesome on the south shore, was completed in less than one hour's time, and at an expense of less than one hundred dollars each.

I have received every possible assistance from Mr. Meriam and M. Maillefert, and their working force; and the free use of two metallic life and surf boats from Mr. Joseph Francis, for all my examinations under your instructions; and cannot close this report without adverting to the *great advantage*, and most *decided economy*, in the use of Mr Francis's metallic boats *at all times and in all places*.

His boats have been in constant use for months, *on* and around the rocks at Hell Gate, and are now in daily use, and *perfect order*, *without the expenditure of one cent for repairs*. No collision (by any exertion of

their crews) with the rocks hurts them, and we have purposely placed them directly over the charges of 125 lbs. of powder, and blown them up with the concussion of the water, without the slightest injury.

Respectfully submitted.

Your obedient servant,

WASH'N N. BARTLETT.

Prof. A. D. BACHE,

Superintendent, Washington.

APPENDIX No. 57.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury, upon an examination in reference to a light-house at Humboldt harbor, California, made by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey.

COAST SURVEY OFFICE,

November 19, 1851.

SIR: I have the honor to report, in conformity with the law approved March 3, 1851, and the instructions of the Treasury Department, that the examination of the necessity for a light-house at Humboldt harbor, California, has been made, and the following is the report of Lieut. Com. James Alden, United States navy, assistant in the coast survey, by whom the examination was made. A sketch of the reconnaissance is herewith enclosed.

"On the north spit I have marked the place where I think the light-house should be located. It is the nearest point to the entrance, and is, therefore, less liable to be obscured by fog; and, with a beacon further back, the two would form the best range to pass between the north and south breakers—not that it should be attempted in the night, unless under the most favorable circumstances. As Humboldt is rather out of the way of vessels passing up and down the coast, I have thought that a light of the second or third class would answer the purposes required at that point, and be sufficiently large for vessels bound in to maintain their position during the night."

I concur with Lieut. Com. Alden in the recommendation of a light of the third order, with a beacon light in rear, to give a range.

The department will decide whether authority exists to put up the proposed beacon as well as the light-house; and if not, I would respectfully request that an appropriation for it may be asked.

The tower of the light-house should be about twenty feet high, and the beacon be so placed that it will be still visible when running on the range line. It should be constructed so as to be moved without difficulty in case of a change in the interior.

Very respectfully, yours, &c.,

A. D. BACHE, *Superintendent.*

Hon. THOS. CORWIN,

Secretary of the Treasury.

APPENDIX No. 57, *bis*.

Letter of the Superintendent of the Coast Survey to Hon. Joseph Grinnell, of the Committee on Commerce, H. R., communicating a report of Lieut. Bartlett, U. S. N., assistant coast survey, on the importance of a light-house at Humboldt harbor.

COAST SURVEY OFFICE,
January 24, 1851.

DEAR SIR: I herewith transmit, for the information of the Committee on Commerce, a report in relation to the importance of a light-house at Humboldt harbor, California, by Lieutenant Washington A. Bartlett, United States navy, assistant in the reconnaissance of the western coast.

Yours, respectfully,

A. D. BACHE,
Superintendent Coast Survey.

HON. JOSEPH GRINNELL,
of the Committee on Commerce.

—
WASHINGTON, January 24, 1851.

SIR: For the information of the Committee on Commerce of the House of Representatives, on the importance of a light-house at *Humboldt harbor*, State of California, I have to state, that Humboldt harbor, although only *discovered* in April, 1850, is already a seaport of great commercial importance in the coasting trade on the western coast.

Humboldt harbor is an extensive sheet of water, of good depth, having an easily accessible entrance from the sea, of about one mile in width.

The bar, having three fathoms at low tide, is one and a half mile outside of the sand points which form the entrance to the harbor.

The sea-shore is low, the sea-side of the harbor being narrow sand points, but slightly elevated above the sea; and hence a light-house is of the first importance to point out the entrance and proper bearing for crossing the bar. Large settlements—Humboldt, Eureka, and Union Town—have already been established on Humboldt bay, whence a road of forty miles communicates with the rich and extensive gold region of the Trinity and Klamath rivers.

The valley, which is watered by the streams which flow into Humboldt bay, is of exceeding fertility, and densely timbered with valuable forest trees.

The steam propellers from San Francisco to Oregon touch at Humboldt, and, before a light-house can be built, there will be a semi-weekly line of steamers between San Francisco and Humboldt. The best position for the town can only be determined by a survey of the entrance.

Very respectfully, your obedient servant,

WASHINGTON A. BARTLETT,
Lieutenant U. S. N., Assistant Coast Survey.

Prof. A. D. BACHE,
Superintendent U. S. Coast Survey.

APPENDIX NO. 10

Very respectfully,
 J. M. Smith, Secretary of the Board of Trade,
 of the Committee on Commerce, U. S. House of Representatives,
 Boston, U. S. A., assistant to the Secretary of the Board of Trade.

COAST SURVEY SERVICE

Dear Sir: I have the honor to acknowledge the receipt of your letter of the 10th inst., in relation to the importance of a light-house at Humboldt harbor, California, by Lieutenant Washington A. Barrett, United States navy, assistant in the reconstruction of the western coast.

A. D. BACCH

Hon. Joseph Gurnea,
 of the Committee on Commerce.

I have the honor to acknowledge the receipt of your letter of the 10th inst., in relation to the importance of a light-house at Humboldt harbor, California, by Lieutenant Washington A. Barrett, United States navy, assistant in the reconstruction of the western coast. Humboldt harbor is an extensive sheet of water, of great depth, having an easily accessible entrance from the sea of about one mile in width. The bar, having three fathoms at low tide, is one and a half mile on each side of the sand points which form the entrance to the harbor. The anchorage is low, the sea-side of the harbor being narrow sand points, but slightly elevated above the sea; and hence a light-house is of the first importance to point out the entrance and proper bearing by crossing the bar. Large settlements—Humboldt, Eureka, and Eureka City—have already been established on Humboldt bay, which is one of forty miles communication with the rich and extensive gold region of the Trinity and Klamath rivers.

The valley, which is watered by the streams which flow into Humboldt bay, is of exceeding fertility, and already planted with various crops. The same property from San Francisco to Oregon, north of Humboldt, and before a light-house can be built there will be a great increase in the number of steamers between San Francisco and Humboldt. The position for the town can only be determined by a survey of the anchorage.

Very respectfully, your obedient servant,
 WASHINGTON A. BARRETT.

Lieutenant U. S. N., Assistant Coast Survey.

Paul A. D. Bachman,
 Superintendent U. S. Coast Survey.

ALPHABETICAL INDEX.

A.

- Adams, H.* Topography of Florida, 71.
Agassiz, Professor L. Florida reef, 12, 68, 69; report on Florida and reefs, 145.
Alcatraz, 522, 523.
Alden, Lieutenant J. Account of Humboldt and Trinidad bays, 520; Trinidad, Humboldt, and San Diego bays, 528; death of De Koven, 533; report on steamer Jefferson, 538; hydrography of western coast, 87.
Alden, H. O. Letter on telegraphic longitudes, 462; thanks to, 29, 30.
Almy, Lieutenant J. J. Hydrography of section III, 53, 55; letter on Fishing Battery light, 482.
Appendix to report—list of contents, 161.
Appropriations, effect of, on progress of work, 7; for western coast urged, 23; for light-houses in section I, 43; for light-houses, buoys, &c., law, 443.
Aransas Pass, 80; letters on lights at, 507.
Archives and library, 99.
Army officers on coast survey, 9; list of, 114.
Astronomical observations. Mount Pleasant, 32; Cape Small, 33; Philadelphia, 44; Causten's, section III, 47; Portsmouth, Virginia, 56; Charleston and Savannah, 64; Western coast, 85.
Azimuths at Mount Pleasant, 32; Causten's, section III, 47; Savannah, 64; list of, between stations, 162 to 442.

B.

- Bache, Professor A. D.* Astronomical observations at Mount Pleasant, Maine, 32; Ossipee and Cape Small, 33; Causten's, section III, 47; discussion of Cat Island tides, 74, 127; currents, 136.
Baker, Woods, office, 100.
Bartlett, Lieutenant W. A. Letter on Cape Hancock, 519; report on California coast, 525; Columbia river commerce, 527; remarks on McArthur, 510; Hell Gate report, (see list of errata,) 46, 553 to 558; Humboldt Harbor light, 559.
Beacons recommended, list of, 460; examinations for, law, 14.
Beacon ranges, New York harbor, 43, 471.
Beaufort. Topography, 58; hydrography, 59; H. L. Whiting's report on, 482; lights, &c., 485.
Billingsgate shoal, 454.
Biloxi Bay, triangulations and topography of, 76.
Block Island. Hydrography, 40.
Blunt, E. Hudson river triangulation, 44; Chesapeake triangulation, 50.
Boca Grande, 72.

- Bolles, C. P.* Triangulation and topography, Cape Fear, 157; Edisto triangulation, 65.
Bond, Professor W. C. Galvanic clock, 11; connects coast survey with Nova Scotia survey, 29; longitudes, 34, 35.
Boston Harbor, rock in, 31; beacons, &c., 453; sailing-marks, &c., 469.
Bottom of sea, form of, off shore, section II, 42.
Boutelle, C. O. Reconnaissance, section I, 32; triangulation, section I, 36; observations at Savannah, 64.
Building for coast survey recommended, 92.
Buoys, examinations for, law, 14; list of those recommended, 460.

C.

- Cape Cod*, topography of, 38.
Cape Fear. Triangulation and topography, 57.
Cape Hancock, Columbia river. Description, light, &c., 517.
Cape Small, observations at, 33.
Cat island. Buoys, &c., 502; tides, 74, 127 to 136.
Causten's station, observations at, 47.
Cedar keys, 489, 494; lights, 494; tides and currents, 493.
Charleston. Large map of harbor, 63, 487; hydrography, 66.
Chatham harbor, 28; topography, 38.
Clopper's bar, 504, 505.
Coast survey approved by geographical societies, 7.
Columbia river, 83, 85; commerce of, 527; sailing directions, 530.
Computing department. Detailed account of work done by each computer, 92.
Connecticut river. Hydrography of mouth, 45.
Coral reefs. Report by Agassiz, 153.
Core sound, 57.
Corwin, steamer, 88.
Cost of surveying by triangulation, &c., 7, 8.
Cox's ledge, survey of, 46.
Cram, Capt. T. J. Triangulation in section I, 36.
Craven, Lieut. T. A. Galveston and Aransas, hydrography, 80, 81, 504, 505, 507.
Crystal river and bay, Florida, 491.
Currents. Section I, 41; mode of indicating observations of, 136.
Cutts, R. D. Triangulation and topography of western coast, 85; Fort Point, Alcatraz, 522, 523; Farrallones, 524.

D.

- Davidson, G.* Astronomical observations, Western coast, 85.
Dean, G. W. Latitude observations, section I, 32; magnetic observations, 33; observations at Causten's, 47.

Declination observations by Prof. Mitchel, 12.
DeKoven, Passed Midshipman W., death of, 88, 533.

Directions for coast survey, 8.

Discoveries and new results of coast survey, 10; list of, 126.

Distances between stations, list of, 162 to 442.

Distribution of coast survey parties, list of, 108; of coast survey maps, 98.

Dorchester channel, buoys, &c., 471.

Drawing department, remarks on, 90; detail of work by each member of, 94.

E.

Edisto, hydrography and topography, 66.

Electro-magnetic recording, Prof. Mitchel, 137.

Electrotyping, remarks on, 91; list of plates copied, 97; report on process, methods, results, laboratory, &c., 541 to 553.

Engraving department, remarks on, 90; details of work by each member of, 96.

Errata, list of, vii.

Estimate for 1852-'53. Section I, 23; sections II, III, and IV, 24; V to IX, 25; Florida reef, 26; Western coast, 26.

F.

Farrallones, 524.

Farley, J. Secondary triangulation, section III, 50.

Florida. Reef, 12; appropriation for, urged, 22; estimate for 1852-'53, 26; harbors, reef, and tides, 68, 69; report on topography of, Agassiz, 145; lights, &c., 457; Gerdes' reconnaissance of, 488 to 494; railroad across, 493; survey of, 492.

Fishing Battery light-house, 481.

Fort Point, 522, 523.

Frying-pan shoals, light on, 59, 62.

G.

Galvanic wave, velocity of, 48; report on wave time by Walker, 476.

Galveston bay, survey of, 78; hydrography, 80; lights proposed, 504, 505.

Geodetic method, practicable, where tried, 8; remarks on, and elements used, 163.

Geographical positions. Remarks on list, 6, 14; list of, 162 to 442.

Gerdes, F. H. Reconnaissance and triangulation of Florida, 70, 488; Cedar Keys light-house examination, 73.

Gibbes, Prof. L. R. Charleston observations, 64.

Gibson, Lt. A. A. Office duties, 90; sketches of geographical positions, 94.

Gilbert, S. A. Triangulation of Biloxi Bay, 76.

Gloucester, Massachusetts, 37.

Glück, J. B. Topography Chatham, 28; Cape Cod and Chatham topography, 38; beacon range surveys, New York harbor, 45, 472; topography of Patapsco, 51.

Gordon, W. W. Tidal discussions, 100.

Greenwell, W. E. Topography section VIII, 76.

Half stream. Soundings, 72; Agassiz on, 157.

H.

Hassler, J. J. S. Triangulation Currituck sound, 57.

Harrison, A. M. Topography Western coast, 86; letter on Point Pinos, 513; on Point Loma, 515; Cape Hancock, 517.

Harvard Observatory, longitude of, 480.

Heights, measured and verified, 37.

Hein, S. Disbursing agent, 90; disbursements, 100.

Hell Gate. Submarine blasting, 46; report on, 553 to 558. (See list of errata.)

Hilgard, J. E. Magnetic observations, 34; Florida triangulation, 70; charge of computing department, 89.

Hodge, W. L. Letter to Prof. Bache, directing light-house examinations, law, 443.

Holmes's Hole. Lights, 466, 467.

Horn Island pass. Sailing directions, 503.

Hudson river triangulation, 44.

Humboldt harbor, 84, 87, 520, 528.

Humphreys, Capt. A. A. Brevet recommended, 18.

Hunt, Lieut. E. B. Charge engraving department, 89, 96.

Hydraulic printing press, 92.

Hydrography in section I, 39; section II, 45; section III, 53; section IV, 58; section V, 66; section VI, Florida, 71, 72; section VIII, 77; section IX, 80; Western coast, 87.

Hydrographic. List of notices, 13; list of sketches in report, 12; list of parties, 108; officers and vessels, list of, 115, 118, 122.

I.

Instrument-making and repairs, 99.

J.

Jefferson, steamer, loss of, 88; correspondence on loss, &c., 533 to 541.

Jenkins, Lieutenant T. A. Light-house examinations, section II, 44; Hatteras inlet, Frying-pan shoals, Cape Fear river, and deep-sea soundings, 59; lights, &c., near New York, 475; report on steamer Jefferson, 538.

Johnson, W. M. Topography in section III, 52.

K.

Kendall, Professor E. O. Observations for coast survey, 44, 45.

Key West. Survey of, 72.

King, T. B. San Francisco rocks, 531, 532.

L.

Lake Pontchartrain. Milneburg harbor, 75.

Land Office surveys, 7.

Latitude. Mount Pleasant, 32; Cape Small, 33; Causten's, 47; Savannah, 64; Western coast, 85; list of latitudes of stations, 162 to 442.

Law appropriating for light-houses and organizing Light-house Board, 443, 446.

Lay, Captain G. W. Special duty, 100.

Library of coast survey, 99.

Light houses, buoys, beacons, &c. Appropriations, section I, 30; section II, 43; examinations, &c., section II, 44; section III, 55; section IV, 62; section VI, 73; section IX, 81; Western coast, 84; list of light-house examinations made by coast survey, 451; law directing examinations, 14, 443; where made, 15; law appropriating for, 443; Light-house Board, 446; list of light-houses recommended, 460; list of light-house sketches in report, 13.

LIGHT-HOUSE, &C., LETTERS—

Lieutenant J. Alden, 520, 528, 558.

Lieutenant J. J. Almy, 482.

Professor A. D. Bache, 453, 463, 464, 466, 468, 471, 474, 481, 485, 486, 495, 504, 507, 512, 513, 515, 517, 522.

Lieutenant W. A. Bartlett, 519, 526, 559.

Assistant R. D. Cutts, 523.

Lieutenant T. A. M. Craven, 505.

Mr. A. M. Harrison, 513, 515, 517.

W. L. Hodge, 443.

Lieutenant J. N. Maffitt, 455, 485, 486.

Lieutenant C. H. McBlair, 453, 467, 469.

Lieutenant C. P. Patterson, 499, 502.

Lieutenant J. Rodgers, 457, 496, 499.

Lieutenant S. Swartwout, 455.

Lieutenant M. Woodhull, 463, 465.

LISTS—

Army officers on coast survey, 114.

Coast survey parties, distribution of, 108.

Coast survey vessels, 115, 118.

Contents of appendix, 101.

Discoveries and developments of coast survey, 126.

Errata in report, vi.

Geographical positions, 162.

Light-house examinations by coast survey, 451.

Light-houses recommended, 460.

Light-house sketches in report, 13.

Maps engraved, 160.

Maps engraving, 161.

Naval engineers on coast survey, 121.

Naval officers on coast survey, 115, 118.

Plates electrotyped, 97.

Results of coast survey, 123.

Sketches engraved, 161.

Sketches engraving, 162.

Longfellow, A. W. Topography, Newburyport, 39.

Longitudes. Observations and computations, 11; by chronometers, moon culminations, and telegraph, Walker and Bond, 34; Hudson, Ohio, 46; Harvard Observatory, 50; Charleston and Savannah, 46; Portsmouth, Va., 56; New Orleans, 76; Cambridge and Halifax, 462; list of longitudes of stations, 162 to 442; methods used in obtaining, 164; from Greenwich, 164; report by Walker on, 480.

Longstreth, M. F., formula by, 49.

M.

Maffitt, Lieut. J. N. Rock in Boston harbor, 31; hydrography of Beaufort, 58; Charleston, N. Edisto, and Savannah, 66, 67; Cape Fear and New river, 59; lights, &c., sections IV and V, 455; of Beaufort, 485; of Cape Fear, 486.

Magnetic observations. Maine stations, 33, 34; Causten's, section III, 47; Western coast, 85.

Manchester, Mass., 38.

Maps, list of, engraved, 160; in engraver's hands, 161; distributed and sold, 98.

Mathiot, G. Electrotpe report, 541 to 553.

McArthur, Lieut. W. P., tribute to, 82; proceedings of meeting, 509; sailing directions Columbia river, 530.

McBlair, Lieut. C. H. Light-house examinations section I, 30, 31; hydrography Nantucket, Muskeget, 39; off Gay Head, Wellfleet, 40; letter on lights, &c., section I, 453; Holmes's Hole, 467; Boston harbor, 469, 471.

McMurtrie. Views Western coast, 87.

Meteorological register at stations in Maine, 33, 34; Causten's, 50.

Mississippi delta, 75, 77, 78.

Mitchel, Prof. O. M. Report on electro-magnetic recording of N. P. distances, 137.

Mitchell, William. Observations at Nantucket, 35.

Mobile bay, 75; hydrography, 77; Patterson's report on buoys, beacons, &c., 499.

Mode of surveying, 163.

Moon culminations, computations, 49.

Mount Pleasant, Me. Azimuths, latitude, 32; longitude, magnetic observations, 33.

Murray, Lieut. F. K. Commands Jefferson when lost, 88; report on loss of, 534; orders survey of, 537; reports on fitness of, 540.

Murphy, H. C. Orthography of names, section II, 46.

Muskeget channel, 39.

Musquito inlet, 72, 73; Rodgers' reports, 495, 496; Prof. Bache's, 495.

N.

Nantucket Shoals, 10, 39, 40; beacon on, 453.

Navy officers on coast survey, 9; list of, 115, 118; engineers, 121, 122.

Newburyport. Topography, 39; hydrography, 42.

New York harbor. Beacon ranges, Flynn's Knoll, &c., 43, 471, 472, 474, 476.

No-man's-land channel, 40.

N. Edisto. Sailing directions, 488.

Nova Scotia. Survey connexion, 29.

O.

Observations, publishing, recommended, 22.

Occultations. Prof. E. O. Kendall, 44.

Office. Summary of work, 22, 89; organization, 89.

Officers, army, employed on coast survey, 9; list of, 114; navy do., 9; list of, 115, 118; naval engineers, 121, 122; coast survey officers, where employed, 108.

Off-shore, hydrography section II, 45; chart, currents, and sections, 42, 43.

Organization of coast survey, plan of, 3, 4, 6.

Orthography of names, section II, 46.

Ossipee, Me., 33.

P.

Pamplico sound, 57.

Parties of coast survey, distribution of, 108.

Pass Christian, 75; hydrography, 77.

Patapsco. Topography, 51.

Patterson, Lieut. C. P. Gulf coast lights, &c., 75; Mobile beacons and buoys, 499; Cat and Ship islands do. buoys, 502.

Pendleton, Prof. Off-shore angles, 45; Computations, 49, 100.

Plan of coast survey organization, 3, 4, 6, 8; law directing it, 9.

Pleasanton, S. Light-houses appropriated for, 449.

Point Conception, 83, 85; light, 512; latitude and longitude, 512.

Point Loma. Description, light, 515.

Point Pinos light, description, 513.

Pond Island, Me., light, 463.

Portsmouth. Hydrography, 42.

Pourtales, L. F. Longitude Portsmouth, Va., 56; signals and triangulation Florida reef, 70.

Powell, H., aids Jefferson's crew, 88.

Powow hill, height of, 37.

Prince, Major H. Reconnaissance section III, 50; Pamplico, 57.

Printing department. Printing done, 98.

Progress. Appropriations influence, 7; now equals 3-8ths of the whole work, 8.

Publishing, plan of, 5; observations, 22; maps, 98.

R.

Rebecca shoals, 69, 73, 74; light or beacon, 498.

Reconnaissance. Section I, Boutelle, Prince, 31; section III, 50; section IV, 56; section VI, 69.

Red Fish Bar, 506.

Refraction, lateral, 70.

REPORTS, (scientific)—

Prof. Bache on Cat Island tides, 127 to 136.

Prof. Bache on current charts, 136, 137.

Prof. Mitchel. Electro-magnetic recording, 137 to 145.

Prof. Agassiz on Florida reefs, 145 to 160.

Computing department. List of geographical positions, 162 to 442.

S. C. Walker on galvanic wave time, 476 to 479.

S. C. Walker on longitudes, 480, 481.

G. Mathiot on electrotyping, 541 to 553.

Results of coast survey, table of, 123 to 125.

Rodgers, Lieutenant J. Florida tides, 69; Key West, hydrography; Boca Grande, Musquito inlet, 72; signals for pilots, 73, 497; letter on Florida lights, 457; on Musquito Inlet, 495, 496; Rebecca shoals, 499.

Rockport, Massachusetts, 38.

Rush, Lieutenant R. H. Drawing department, 89, 94.

S.

Sale of maps urged, 91, 99.

Salem Harbor. Hydrography, 40.

San Diego bay, 83, 87; description, sailing directions, 528.

Sandy Hook, 45.

San Francisco, &c., 84; topography, Alcatraz, Fort Point, Yerba Buena, Mare Island, 85, 522; sunken rocks in harbor, 531, 532.

Sands, Lieutenant B. F. Hydrography section III, 54; section VIII, 75, 77.

Savannah. Observations for latitude, longitude, and azimuth, 64; topography and hydrography, 66.

Saxton, J. Charge of instrument-making, 89.

Scientific. See reports.

Screw-pile signals, 70.

Sea-horse reef, 73.

Sections. Summary of work in section I, 18; II, 19; III, 19; IV to XI, 20. Work done in the year, section I, 27; II, 42; III, 47; IV, 55; V, 62; VI, 67; VIII, 74; IX, 78; X and XI, 81. Limits of sections, 16, 17, 162.

Seib, J. Topography of Chesapeake, 51.

Ship channel, Florida reef, 154.

Ship island. Buoys, 502.

Shovelful shoals. Light-boat, 464, 455.

Signals on Florida reef, 70, 71; Rodgers' pilot signals, 73, 497.

Sketches, preparation of, 91; list of, in report, 106; list of, engraved, 161; engraving, 162.

Snow, C. B. Librarian, &c., 99.

Sow-and-pigs light, 453.

Stations, preservation of, Texas, 79; how marked, 165; list of their latitudes, longitudes, azimuths, and distances, 162 to 442.

Statistics of work, 10; of coast survey results, 123 to 125.

Steamer Jefferson, loss of, 17, 88, 533 to 541; Corwin, 88.

Stevens, Major I. I. Assistant in charge of office, 6, 89; inspection section I, 29; remarks on McArthur, 511.

Suwannee river and bay, 489.

Swartwout, Lieutenant S., 31; No-man's-land channel, 40; off-shore soundings, 41; Cox's ledge, 46; lights, &c., in section I, 455.

T.

Telegraphic longitudes, 35.

Tides. Observations, 11; section I, 29, 41; Cat island tides, 74; discussion of, by Prof. Bache, 127; Mr. Schott, 94; tidal reductions, 99; discussions, 100; Galveston tides, 79.

INDEX.

v

Topography. Section I, 37; section III, 51, 52; section IV, 58; section V, 66; section VI, 71; section VIII, 76; section IX, 80; western coast, 86; topographical description of Florida, Agassiz, 147.

Totten, Lieutenant James. Florida, 71.

Transits. Prof. Kendall, 44.

Transportation of navy officers estimated for, 23.

Trenholm, G. W. Letter on Charleston harbor chart, 487.

Triangulation. Section I, 32, 36; section II, 44; section III, 50, 51; section IV, 57; section V, 64, 65; section VI, 70; section VIII, 76; section IX, 79; Western coast, 85; progress of triangulation, 17; method of, 163.

Trinidad bay, 87, 521, 528.

Trowbridge, Lieutenant W. P. Triangulation section I, 32; discussions, 100.

V.

Velocity of galvanic wave, 48, 476.

Verification. Sections II and III, 4.

Vessels of coast survey, 115, 118.

W.

Wacassassa bay, 490.

Wadsworth, A. S. Triangulation, section IV, 58.

Wainwright, Lieutenant R. Hydrography section IV, 58.

Wainwright, S. A. Topography of Chesapeake, 52; Savannah river, 66.

Walker, S. C. Longitudes, 34; observations, 46; telegraphic, 48, 49; in section IV, 56; letter on telegraphic, 462; report on galvanic wave time, 476; on longitudes, 480.

Wampler, J. M. Galveston topography, 70.

Wellfleet. Topography, 38; changes, 40.

Western coast. Plan of survey, reasons, 4, 5; estimate for 1852-'53, 26; operations on, 81, 83; lights, &c., on, 468.

Whiting, H. L. Topography Cape Ann, 37; Sandy Hook resurvey, 45; Beaufort, 58, 482.

Whiting, Lieutenant W. B. Hydrographic examinations in office, 99.

Williams, J. S. Triangulation Galveston bay, 79.

Wise, G. D. Topography section III, 52; Edisto, 66.

Withlacoochee bay, 491.

Woodhull, Lieutenant M. Chatham harbor, 28, 41; Portsmouth, Newburyport, 42; tidal observations section I, 41; light-house examinations, 44; off-shore soundings, 45; mouth of Connecticut river, 45; Shovelful shoals light-boat, 465; lights, &c., near New York, 475.

Y.

Yulee, Prof. Computations, 49.

Errata in the list of Geographical positions, discovered after the report was printed.

"

NOTE.—Discrepancies of 0.01, arising from increasing the last figure by a unit, when the figure in the third place of decimals was 5, while in similar cases the 5 was dropped, are not noticed in this list.

				"	"
P. 168, station	Quaker,	column	longitude, read	57.32	for 37.34.
P. 169, "	Pocasset,	"	latitude, "	07.23	" 07.20.
P. " "	"	"	longitude, "	11.33	" 11.36.
P. 218, "	Mt. Independence,	"	longitude, "	53.04	" 53.07.
P. 304, "	Maulden's Mt.,	"	latitude, "	12.01	" 11.98.
P. 324, "	Smith's Pt. Light,	"	longitude, "	58.30	" 58.50.
P. 372, "	Pt. Lookout,	"	longitude, "	04.86	" 04.90.
P. 374, "	Wolftrap,	"	longitude, "	24.32	" 24.22.
P. 375, "	C. Henlopen,	"	longitude, "	44.55	" 45.55.
P. 378, "	South Birch,	"	longitude, "	10.51	" 08.51.

LIST OF ERRATA.

Page 11, line 8 from bottom, for reduced read recorded.

Page 17, line 32 from top, for VI read VII.

Page 33, line 4 from top, for Sebattis read Mount Independence.

Page 34, line 11 from bottom, for Liverpool read Greenwich.

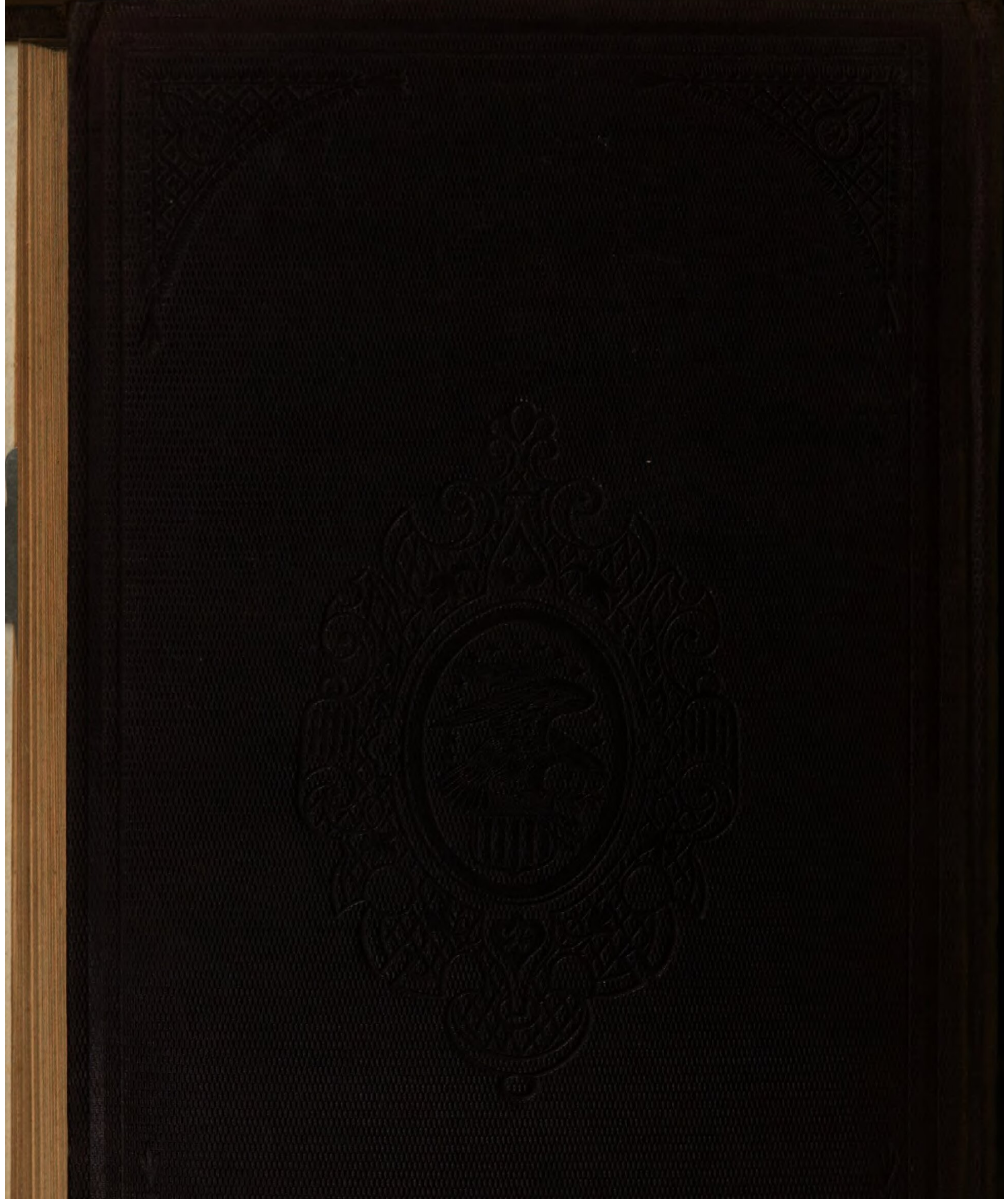
Page 34, line 10 from bottom, for 39.96 read 29.96.

Page 36, line 21 from top, for Mason read Nason.

Page 92, line 15 from bottom, for Charles N. Schott read Charles A. Schott.

Page 378, line Longitude of South Birch, for $75^{\circ} 10' 08''.51$ read $75^{\circ} 10' 10''.51$.

Pages 553 to 558. The depth on Pot Rock was found, in the subsequent survey by Major Frazer, to be 18 feet, and, after additional blasting, three points of 19 feet 3 inches remained, December, 1852.



Senate documents

Bd.: [70,1.] 1851 (1852) = Doc. Nr. 3 = Congress 32, Sess. 1

Washington, DC 1852

Am.b. 3040-70,1

urn:nbn:de:bvb:12-bsb11036963-9